Proceedings of the 2013 International Conference on Technology Innovation and Industrial Management

29th–31th May 2013
Phuket, Thailand

Proceedings of the 2013 International Conference on Technology Innovation and Industrial Management
29th–31th May 2013 • Phuket, Thailand

Edited by Pornthep Anussornnitisarn, Bordin Rassameethes, Haruthai Numprasertchai, and Nam Q.

Published by ToKnowPress
Bangkok • Celje • Lublin • Malta
www.toknowpress.net

https://toknowpress.net/ISBN/978-83-65020-63-5.pdf
https://www.doi.org/10.53615/978-83-65020-63-5

BY-SA © Authors

ToKnowPress
www.toknowpress.net

Table of Contents

Session 1: Strategic Management- policies, risk, new markets, pricing, outsourcing and value chains

Session 2: Financial management in industrial operations- branding, investment, and cost management

Session 3: Management of technology and innovation- applications, cases, and new product/ service development

Session 4: Productivity and quality management- process improvement and customer focus

Session 5: Decision theory and analysis- process and decision-making tool

Session 6: Change and contemporary management- human capital and emerging trends for future management

Session 1: Strategic Management- policies, risk, new markets, pricing, outsourcing and value chains

S1 - 1	Project management in Asian car companies *Supachart Iamratanakul*
S1 - 17	Strategic information and customer-oriented systems: the role of competitive priorities *Oscar F. Bustinza, Daniel Arias-Aranda and Vanesa Barrales-Molina*
S1 - 18	Perceived risks and risk reduction strategies in online group-buying *Fei-Fei Cheng, Tien-Yin Liu and Chin-Shan Wu*
S1 - 26	An analysis of pricing telecommunications network services with data mining methods *Jongsawas Chongwatpol*
S1 - 38	New connect in comparison with multilateral trading facilities in Europe. irregularities in the functioning of the polish MTF market. *Roman Asyngier*
S1 - 55	Correlated risk assessment and its managerial applications *J. N. Pan and Sheau-Chiann Chen*
S1 - 75	Popular online promotion strategies among different industries *Chin-Shan Wu, Yi-Ting Huang and Fei-Fei Cheng*
S1 - 76	Innovations in higher education system, based on the example of the faculty of economics, Maria Curie-Skłodowska university, project synergia case *Agnieszka Sitko-Lutek and Aneta Karasek*

S1 - 86	Innovations in the context of risk management *Anna Karmańska, Tomasz Michalski and Adam Śliwiński*
S1 - 103	Formulation of marketing information and communication strategies in Taiwan tourism industry *Tzong-Ru(Jiun-Shen) Lee, Yu-Hsuan Kuo and Per Hilletofth*
S1 - 112	Is habit influenced construct for online repurchase intention? *Chinho Lin and Watcharee Lekhawipat*
S1 - 127	Product portfolio management - current challenges and preconditions *Arto Tolonen, Hanna Kropsu-Vehkapera and Harri Haapasalo*
S1 - 145	Surname as a luxury brand: brand value perspective *Barbara Mróz-Gorgoń*
S1 - 157	An investigation of key successful factors of biotechnological industry performance in Taiwan ~ also an analysis of traditional Chinese medicine *Shang-Yung Yen, Shu-Mei Tang and Wei-Chih Wu*
S1 - 171	The effect of the minimum wage on the competitiveness of economy *Anna Krajewska, Piotr Krajewski and Katarzyna Piłat*
S1 - 190	The value chain of a sustainable development organisation *Jan Chadam, Malgorzata Polkowska Zbigniew Pastuszak and Nada Trunk-Sirca*
S1 - 202	Outsourcing strategies and negotiation power in security sector *Jouni Juntunen, Mari Juntunen, Vesa Autere and Pekka Kess*
S1 - 215	Do training funds raise the pace of training? The case of Mauritius *Oluyemisi Kuku, Peter F. Orazem, Sawkut Rojid and Milan Vodopivec*
S1 - 236	The role of fair trade in developing corporate social responsibility: an empirical examination based on multiple cases *Khuram Shahzad and Ilkka Sillanpää*
S1 - 256	Employees' theft behaviour: a study in large retail organisations in Kuala Lumpur *M. Krishna Moorthy, Felix Chee-Yew Ng, Mahendra Kumar a/l Chelliah, King-Tak Yew and Lee Ah Suat*
S1 - 267	AEC and Thailand brand *Yupin Patara and Nicha Tanskul*
S1 – 269	The importance of building and rebuilding trust in organizations *Joanna Paliszkiewicz*
S1 - 279	To develope Taiwan tourism development strategies based on the travel experience in Thailand *Tzong-Ru (Jiun-Shen) Lee, Hui-Chu Tung and Cheng-Chun Hsieh*

S1 - 286	Conceptual strategic framework for decision support system of Thai fruit *Sawang Panjun and Punnamee Sachakamol*

Session 2: Financial management in industrial operations- branding, investment, and cost management

S2 - 1	Formation of brand evidence in retail banks *Chiachi Tsan and Hsin-Fu Chen*
S2 - 19	Life insurer financial management: space risk analysis in the case of Poland *Adam Śliwiński*
S2 - 33	Can heuristic valuation improve investment performance of individual in investors? *Mariusz Kicia*
S2 - 50	Influence of globalization and integration processes on accounting regulations on the example of Poland *Małgorzata Kamieniecka*
S2 - 65	Investment analysis in public-private-partnership projects: any common ground for public and private investors? *Pekka Leviäkangas, Pekka Kess and Jaakko Kujala*
S2 - 79	Influence of project management maturity on projects' costs *Seweryn Spalek*
S2 - 86	Business models in construction – construction managers' viewpoint *Aki Pekuri, Laura Pekuri and Harri Haapasalo*
S2 - 88	Threat of insolvency of private sector companies on the example of Poland, Czech Republic and Slovakia *Justyna Franc-Dąbrowska and Małgorzata Porada-Rochoń*
S2 - 98	The selection of project in rapid environment's industry using zero based budget *Supachart Iamratanakul*
S2 - 110	Comparing manufacturing and services sourcing against R&D sourcing *Marzieh Shahmari Chatghieh, Harri Haapasalo and Anyanitha Distanont*
S2 - 131	A conceptual model of corporate entrepreneurship in banking industry *Bobby Boon-Hui Chai and Harry Entebang*
S2 - 137	Extending the UTAUT model in M-banking adoption *Ching-Mun Cheah, Aik-Chuan Teo, Keng-Boon Ooi and Jessica C.J. Wong*

S2 - 142	Using sustainable competitive advantages to measure technological opportunities *Josu Takala, Matti Muhos, Sara Tilabi, Mehmet Serif TAS and Bingli Yan*
S2 - 164	The relationships among stocks, bonds and gold: safe haven, hedge or neither? *Shu-Mei Chiang, Chi-Tai Lin and Chien-Ming Huang*
S2 - 181	Warrant SEOs in an emerging market: evidence from Thailand *Polwat Lerskullawat*
S2 - 197	Business justifications for rapid productisation in small- and medium -sized companies *Kai Hänninen, Matti Muhos and Harri Haapasalo*
S2 - 211	Institutional arrangement, technological innovation and application evolution: the rise of China's emerging computing infrastructure *Jiang Yu and Yue Zhang*
S2 - 239	Inter-organizational relationship and innovation performance in electronic supply chains *Jao-Hong Cheng , Chih-Ming Lee and Mu-Chung Chen*
S2 - 245	E-business analysis of real estate companies *Delvin Grant and Emna Cherif*
S2 - 257	Exploring the dynamic interdependence in the east Asian stock markets *Suthawan Prukumpai and Yuthana Sethapramote*
S2 - 279	Organizational learning: a mediating factor between technological innovation and TQM *Voon-Hsien Lee, Keng-Boon Ooi, Chee-Keong Choong and Kee-Luen Wong*
S2 - 282	Determinants electricity demand in industry and households *Štefan Bojnec and Drago Papler*
S2 - 283	Developing credit rating indicators of customers for electronic companies *Hsiao-Chen Chang, Kuang-Hsun Shih, Ming-Fang Lee and Yi-Hsuan Chou*

Session 3: Management of technology and innovation- applications, cases, and new product/ service development

S3 - 1	Supervision and protection of e-data in sensitive information systems *Vladimir Šimović, Matija Varga and Marin Milković*
S3 - 25	A novel infrastructure for data sanitization in cloud computing *Cheng-Yuan Ku and Yu-Siang Chiu*

S3 - 29	Electronic word-of-mouth: the moderating roles of product involvement and brand image *Chinho Lin, Yi-Shuang Wu and Jeng-Chung Victor Chen*
S3 - 48	The internet of things: the revolution of tomorrow or the overrated technology of today? *Aelita Skaržauskienė and Marius Kalinauskas*
S3 - 61	The building blocks of consulting service excellence *Adeline A. Pacia*
S3 - 80	Relationship performance on self-service technology: relationship maintenance and perceived relationship investment *Powen Fang, Yaochuan Tsai and Hsinhsin Chang*
S3 - 107	Online media evaluation of disaster management *Panom Gunawong and Jiratiwat Pongnaparuk*
S3 - 117	The antecedents of innovation climate: cross-level mediation perspectives *Li-Yueh Lee and Veasna Sou*
S3 - 139	The antecedents and mediators of new product development success *Les Tien-Shang Lee*
S3 - 161	Conceptualizing productization from the Yin Yang perspective *Tuomo Kinnunen, Harri Haapasalo, Kris M Y Law and Kai Hanninen*
S3 - 162	Threats and the protection of electronic information with regard to social networks *Matija Varga, Vladimir Šimović and Marin Milković*
S3 - 179	Mediating role of knowledge sharing on information technology and innovation *Onwika Kaewchur and Kongkiti Phusavat*
S3 - 189	Grants, enterprise innovativeness and efficiency *Sabina Žampa and Štefan Bojnec*
S3 - 203	The effect of cultural and economic conditionings on innovativeness in economics *Agnieszka Sitko-Lutek and Aneta Karasek*
S3 - 222	Self-disclosure on social network sites in adolescents: the exploratory study of Thai students *Yupin Patarapongsant and Issariya Woraphiphat*

S3 - 238	Development of cloud virtualization technology and its application in manufacturing management system- a case study *Shang-Liang Chen, Cheng-Hung Kuo, Ying-Han Hsiao, Sin-Ru Wang, Yun-Yao Chen and Chiang Hsu*
S3 - 252	Managing knowledge to enhance the performance of the grassroots technological innovation for Thai SMEs *Somchai Numprasertchai and Haruthai Numprasertchai*
S3 - 264	Productisation: a literature review *Janne Harkonen, Harri Haapasalo and Kai Hanninen*
S3 - 297	Website adoption: overview of Malaysian cost engineering firms *Ms. Zarina Syuhaida Shaarani and Abdul Rashid Abdul Aziz*
S3 - 310	System supporting location of service works - case study *Jędrzej Trajer, Małgorzata Jaros, Bronisław Gołębiewski and Radosław Winiczenko*
S3 - 318	A study on the adoption of cloud technology service in tourism *Shu-Ping Lin and Shou-Yen Lin*
S3 - 326	How knowledge integration mechanisms affect product innovation in the NPD process? *Teresa Tiaojung Hsu, Kuen-Hung Tsai and Yi-Chuan Liao*
S3 - 342	Business case analysis for rapid productisation *Tuomo Kinnunen, Kai Hänninen, Harri Haapasalo and Hanna Kropsu-Vehkaperä*
S3 - 355	Green product positioning and purchase intention in Malaysia *Sathiswaran Uthamaputharan and Muslim Amin*

Session 4: Productivity and quality management- process improvement and customer focus

S4 - 1	Measurement of disconfirmation in online purchasing behavior *Chinho Lin and Yu-Huei Wei*
S4 - 11	Exploration of consumers' behaviours connected with product reuse *Monika Nalewajek and Radosław Mącik*
S4 - 24	An evaluation of manual material handling tasks in a manufacturing company *Grepo, Lorelie, Yabis, David John and Po, Ronald Aaron*
S4 - 42	Benchmarking in higher education *Jerzy Woźnickia, Mariusz Luterek and Iryna Degtyarova*
S4 - 54	Brand and corporate image of a sport organization as a factor of building loyalty *Agnieszka Rak*

S4 - 66	Role of monitoring and controlling quality in TQM *Sanjana Brijball Parumasur and Patsy Govender*
S4 - 84	Consumers' perception of retail formats – case of Poland *Radosław Mącik, Dorota Mącik and Monika Nalewajek*
S4 - 98	Customer-based performance on customer relationship management: the role of customer relational information process *Hsinhsin Chang, Powen Fang and Fangju Cho*
S4 - 120	Product quality improvement through response surface methodology: a case study *HE Zhen, ZHANG Xu-tao and XIE Gui-qing*
S4 - 131	The implementation of customer relationship management within Taiwanese banks *Ying-Yueh Su, Yen-Ku Kuo and Bang-Lee Chang*
S4 - 138	Applicability of the (Q,R)-model in maintenance materials management *Antti Puurunen, Jukka Majava, Hanna Kropsu-Vehkapera and Pekka Kess*
S4 - 153	Private higher education in Slovenia *Dušan Lesjak and Vesna Skrbinjek*
S4 - 161	Shopping cart abandonment: a comparison between American and Taiwanese perspectives *Chuleeporn Changchit and Tzong-Ru Lee*
S4 - 175	The impact of online banking on customer service delivery in the Malaysian banking industry: KANO's model approach *Tasmin, R., Alhaji Abubakar Aliyu, Norazlin, H. and Josu Takala*
S4 - 189	The innovation from buyer and supplier's collaboration *Ya Ling Tsai and Huei-Ying Chen*
S4 - 197	TQM and family owned business: performance and sustainability *Boon In Tan, Kee Luen Wong and Chee Keong Choong*
S4 - 205	Customer definition and representation in market-driven product development *Jukka Majava, Jouko Nuottila, Harri Haapasalo and Kris M.Y. Law*
S4 - 222	Why consumers resist mobile payment? A conceptual model *Aik-Chuan Teo, Ching-Mun Cheah, Keng-Boon Ooi and Jessica C.J. Wong*
S4 - 227	The impact of trust and stereotypes on the type of doctor-patient relationship – a study on Polish health care market *Katarzyna Krot*

S4 - 236	Measuring and developing customer satisfaction with the balanced critical factor index method *Mika Kuronen and Josu Takala*
S4 - 245	Public business services in a sparsely populated area – case study *Martti Saarela, Eija-Riitta Niinikoski and Matti Muhos*
S4 - 259	An integrated optimization model for distribution center location with considerations of population and income *Aditi Dwivedi and Namkyu Park*
S4 - 271	Safety culture maturity model in upstream: oli and gas industry in Thailand *Bordin Vongvitayapirom and Kongkiti Phusavat*
S4 - 298	Investigating the perceived of e-leadership style change and its consequence in virtual context *Kai-Tang Fan*

Session 5: Decision theory and analysis- process and decision-making tool

S5 - 1	Evaluating accuracy of a time estimator in a project *Thanh-Lam Nguyen, Wei-Ju Hung, Ming-Hung Shu, Lin-Ying Hsu and Yueh-Hung Yeh*
S5 - 8	Time-dependent vehicle routing problem in Bangkok *Warinda Kiatdherarat, Pathai Suwannawiwat and Kamol Limtanyakul*
S5 - 15	A system dynamics model of trust, knowledge sharing and stability of strategic alliance *Chinho Lin and NguyenDong-Thai Dao*
S5 - 28	Integrating ERP benefits, competitive priorities and performance measures *Oscar F. Bustinza, Daniel Arias-Aranda, Vanesa Barrales-Molina, Carmen Haro Dominguez and Nieves Perez Arostegui*
S5 - 29	Providing semantic interpretation to OLAP queries. Application to hospital management data warehouses. *Carlos Molina, Belén Prados-Suarez, Miguel Prados de Reyes and Carmen Peña Yañez*
S5 - 39	Rule generation based on novel two-stage model *Kuo-Ping Lin, Ching-Lin Lin, Yu-Ming Lu and Ping-Feng Pai*
S5 - 61	Forecasting model for the international tourism demand in Taiwan *Thanh-Lam Nguyen, Jui-Chan Huang, Chuang-Chi Chiu, Ming-Hung Shu and Wen-Ru Tsai*

S5 - 71	Basic quaternary design table using geometrical design *Jen-der Day and Hsien-Tang Tsai*
S5 - 78	Scenario prediction of Japanese software industry through hybrid method *Yasuo Kadono*
S5 - 85	Tool wear condition monitoring in tapping process by fuzzy logic *Ratchapon Masakasin and Chana Raksiri*
S5 - 94	The internet banner ad and users' attitudes *William Flores, Jengchung Victor Chen and William H. Ross*
S5 - 96	Development of MRP Framework for Job Shop Environment *Sakurat Intrto and Pornthep Anussornnitisarn*
S5 - 97	Identifying data quality/ information quality research: framework and evolution *Tan Zhang, Yue Wu1, Hongyun Zhang, Yuewen Liu and W. Huang*
S5 - 109	Validating performance based critical actions in a high tech start-up *Veli-Pekka Vuoti, Josu Takala,Wenshan Yang, Nurul Aida binti Abdul Malek, Yang Liu, Alexander Mäntylä, Patricia Kronman, Andreas Kreuzer and Afnan Zafar*
S5 - 125	Mining it business texts to analyze technology trends *Sumali J. Conlon and Lakisha L. Simmons*
S5 - 126	A value assessment model for sustaintable smart cities *June Wei*
S5 - 128	Mobile ordering system structure and demand analysis *Kuang-Husn Shih, Fu-Ju Yang, Ching-Wen Lin and Ching-Yi Lin*
S5 - 135	Forecasting with Fourier residual modified ARIMA model- the case of air cargo in Taiwan *Thanh-Lam Nguyen, Peng-Jen Chen, Ming-Hung Shu, Bi-Min Hsu and Yi-Chang Lai*
S5 - 147	The civilizational determinants of Poland's development *Elżbieta Mączyńska*
S5 - 160	Enhancing project management – a quality gate usage *Saroj Koul and J. Joshuva Alexander*
S5 - 173	Challenges for knowledge transfer in virtual NPD - case study *Päivi Lohikoski, Anyanitha Distanont and Harri Haapasalo*
S5 - 193	Early stages of technology-intensive companies in southern California *Matti Muhos, Pekka Kess, Lada Rasochova and Del Foit*

S5 - 200	Study on resource allocations for sustainable competitive advantage *Josu Takala, Daryna Shylina, Teppo Fross and Johannes Malmi*
S5 - 218	A demerit control chart for customer satisfaction survey *Worlaluck Jankrajang*

Session 6: Change and contemporary management- human capital and emerging trends for future management

S6 - 1	Mobile tourism the hidden jewel of the tourism industry? *Garry Wei-Han Tan and Keng-Boon Ooi*
S6 - 15	Social network reactions to a flood situation *Panom Gunawong and Phatchayathit Jankananon*
S6 - 25	"Novel smart map" design for the tourism industry *Hsin-Jung Lu and Lee, Tzong-Ru(Jiun-Shen)*
S6 - 34	Personality traits and professional responsibility – preliminary model *Radosław Mącik and Dorota Mącik*
S6 - 51	The hidden cultural management factors in English cram schools *Shao-hua Chang*
S6 - 52	Adequate temperature and humidity for books and people in a library *Bang-Lee Chang, Hui-chen Lee, Yen-Ku Kuo, Ying-Yueh Su and Ching-Tzu Chen*
S6 - 73	Bridging competence and curriculum for complex change *Chi-Cheng Chang*
S6 - 87	Validating knowledge/technology effects to operative sustainable competitive advantage *Josu Takala, Jari Koskinen, Yang Liu, Mehmet Serif Tas and Matti Muhos*
S6 - 103	The antecedents of expatriates' creative engagement *Li-Yueh Lee and Veasna Sou*
S6 - 124	Implementing balanced scorecard of Government MIS Department－using AHP and fuzzy AHP methods *Yi-Hui Liang*
S6 - 132	Organizational competencies and the enterprise's effectiveness *Urszula Skurzynska-Sikora*
S6 - 143	Using clue as a software platform to teach artificial intelligence: continuing investigation and development *Adrian A Angeles, Bernardo Z Cinco and Paul Vincent S Contreras*

S6 - 144	A study on relationship among organizational trust, organizational justice and organizational spirituality *Yen-Ku Kuo, Tsung-Hsien Kuo, Chien-Ting Lin, Yung-Heng Lee, Bang-Lee Chang, Ying-Yueh(Janice) Su and Li-An Ho*
S6 - 151	Relationship between knowledge management practices and library users' satisfaction: a preliminary result of Malaysian university libraries *Che Rusuli M.S., Tasmin R., Takala J., Norazlin H., K Phusavat, Walsh J. and Raja Abdullah Yaacob*
S6 - 174	An empirical study of users' continuance intention and word of mouth toward SNA (social network app) *Huei-Hsia Hsu, Chia-Cheng Chang and Tzu-Hong Lin*
S6 - 184	Training, creativity and innovation *Valerij Dermol and Nada Trunk Širca*
S6 - 194	Market demand, green innovation, and firm performance: evidence from hybrid vehicle industry *Ru-Jen Lin, Rong-Huei Chen and Thao-Minh Ho*
S6 - 210	Drivers for sustainable green supply chain – case of the Indian automobile industry *Saroj Koul and yatish prasad dasari*
S6 - 224	The perceived key factors of public e-service *Chien-I Weng, His-Peng Lu, Kuang-Heng Shih and Kai-ling Chen*
S6 - 241	The relationships among green operations, green innovation, and environmental performance *Rong-Huei Chen, Ru-Jen Lin and Yen-Ju Lin*
S6 - 257	Knowledge dynamics and innovation: case studies in a sparsely populated area *Harri Jokela, Eija-Riitta Niinikoski and Matti Muhos*
S6 - 269	Construction of knowledge creation: a conceptual framework *Khalid Abdul Wahid, Haruthai Numprasertchai and Yuraporn Sudharatna*
S6 - 284	Personal values and gift giving: the case of choosing a restaurant for hosting dinner *Peeraya Lekkumporn*
S6 - 313	Effectiveness of polish and foreign disdcriminant models *Sławomir Juszczyk and Rafał Balina*
S6 - 324	A comparison study between Oracle R12 and manufacturing planning and control theory for MRP implementation *Tippamas Chorpha and Pornthep Anussornnitisarn*

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

PROJECT MANAGEMENT IN ASIAN CAR COMPANIES

Supachart Iamratanakul, Kasetsart University, Thailand
supachart9@gmail.com

ABSTRACT

Purpose *– This paper intends to present personality traits of successful project managers that tend to restrain standardization efforts within organizations yet contribute heavily to success. The paper also determines analyses and recommends various new and existing project management techniques which are used in Asian car companies.*
Design/methodology/approach *- The paper has analyzed the present and future strategies of Asian car market conditions based on interviews and other findings of the company. The project and interview analysis also employed to defines a set of recommendation which these companies can follow as a general project management office (PMO) unit.*
Findings *- Low cost Vehicles are driving the growth of automotive industry in emerging economy, such as China & India. It offers immense opportunities for global players in these economies. Asian countries, such as Thailand, Philippines, Indonesia, Malaysia, are expected to be the potential markets for automotive industry due to AFTA (ASEAN Free Trade Area). From long-term perspective, cheap financing and prices discounts, rising income levels, and infrastructure developments will drive the growth in majority of Asian automotive market. Thailand is emerging as a manufacturing hub for foreign automotive players, due to AFTA under which export tariff are very less.*
Originality/value *- Based on the Asian market, their strategic planning and organizational objective, the paper provides a clarified view of how these automobile companies in Asia work with Project Management Strategies. This contribution is unique for project managers to fit their manufacturing industry needs with the PMO strategies.*

Keywords: Project/ Program management, Asian car market, Project/Program management office, Strategic planning
Classifications: Research paper

PROJECT DESCRIPTION

The project examines, determines, analyses and recommends various new and existing project management techniques which are used in Asian car companies. The information of various popular brands of Asia are collected and are analyzed to perform a survey and a list of interviews to get the best known tools and skills in Asia. Every company has its own project management skill set and its own organizational structure. This project focuses on study of individual company and learns their tools and differentiates them.

The analysis is done to create affair line of difference among these organizations. No matter how similar the product is, or how its structure is complicated. Every organization follows its own project management rules. Type of Project management teams may vary from company to company or maybe even project to project.

Project management skills remain in high demand within Asian organizations. Ironically, project management methods and practices remain inconsistent even though numerous templates, methodologies and repositories are available for use in improving consistency in project management practices (e.g., PRINCE2, PMI BOK).

The paper shows:
1. The personality traits of successful project managers tend to constrain standardization efforts within organizations yet contribute heavily to success. Such characteristics include individual determination, focus, and ability to influence, drive to deadline / key performance indicators;
2. The demands of business sponsors play a major part in subverting initial project objectives;
3. The involvement of external suppliers and system integrators in particular, tends to skew project management within large-scale projects.

Asia has always been popular for its new concepts and for bringing new platform products for the world. Asian car companies have shown a tremendous success rate in the previous years. Now and from the past, they have been innovative and succeeding in newer ventures by following their project management strategies and making changes to them as per the requirements.

China, India & ASEAN countries are the major driving markets for Asian automotive industry. "Asian Automotive Industry (2007)" report provides objective analysis on Asian Automotive industry to explore the potential opportunities and challenges faced by the industry.

The key findings for this paper:
1. Low cost vehicles are driving the growth of automotive industry in emerging economy, such as China & India. It offers immense opportunities for global players in these economies.
2. Asian countries, such as Thailand, Philippines, Indonesia, Malaysia, are expected to be the potential markets for automotive due to AFTA (ASEAN Free Trade Area).
3. From long-term perspective, cheap financing and prices discounts, rising income levels, and infrastructure developments will drive the growth in majority of Asian automotive market.
4. Thailand is emerging as a manufacturing hub for foreign automotive players, due to AFTA under which export tariff are very less.
Poor infrastructure affecting the growth pattern in Asian automotive industry e.g. commercial vehicles dominates Indonesian and two wheelers in Sri Lankan automotive market due to the poor roads.

Key Issues and Facts Analyzed

1. Automotive Industry performance of major Asian countries.
2. What opportunities exist for the automobile players in Asian automotive industry?
3. Major challenges and driving forces for Asian automotive industry.
4. Who are the major competitors in Global Passenger car industry?

Key Players Analyzed

This section covers the key facts about major players currently operating in the Asian automotive industry, such as General Motors, Toyota Motor, Ford, Nissan, Honda, and Hyundai.

THE BACKGROUND OF PROJECT MANAGEMENT

To start this section, one must be understand what a project is. A project is defined by Project Management Institute (PMI) Standard committee in "A guide to the project management body of knowledge" as "A temporary endeavor undertaken to create a unique product or service" (Institute, 2004). A project is a one-time activity with the following attributes (Meredith and Mantel, 2006).

1. A well-defined purpose
2. A life cycle starting slowly, reaching peak, then declining
3. Interdependencies and system interactions within the organization, the industry, and environment in which it exists
4. Uniqueness about its objectives, operational characteristics and outputs
5. Deliberate conflict built into it.

A project can also be considered that (Nicholas, 1990):

- Involve a definable purpose and end result specified in terms of cost, schedule, and performance requirements.
- Cut across organizational lines and utilize skills and talents from multiple disciplines and organizations.
- Involve unfamiliarity, uncertainty, and risks. Given that a project differs from what was previously done, it also involves unfamiliarity.
- Encompass new technology, which, for the organization undertaking that project, possess significant elements of uncertainty and risk.
- Are temporary activities with personnel, material, and facilities assembled to accomplish as goal within a scheduled time frame. Once the goal is achieved, the project ceases to exist. The project resources may be reconfigured to begin work on a new goal.
- Is the process of achieving a goal, going through distinct phases, called the *"PROJECT LIFE CLYCLE"*.

A project includes any series of activities and tasks. Those activities and tasks should be:

- Definable in terms of a specific, finite objective
- Infrequent, unique, or unfamiliar to the existing organization
- Complex with respect to organizational interdependence in detailed task accomplishment
- Critical to the company in terms of extent of commitment in resources, market potential or some other aspect that has significant impact on the company's business position.

The key elements of project management are classified as follows:

Table 1: The elements of project management

Elements	Issues
Project participants	Bring people to frontier Manage people in team
Project organization	Manage organization in multi-function environment Manage people of different functions
The project itself	Start, executed, and control a project Manage the process
Project resources	Manage the resources such as financial resources, supplier, internal resources, etc.
Project system interactions	Interface with external organization Link to outside world
Strategic fit of the project	Manage strategic issues for the project Must have strategic fit in a project

STRATEGIC VIEWPOINT OF THE PROJECT

Projects are building blocks in the design and execution of organizational strategies (Cleland, 1999). This is because a good management of projects can identify a project's priority and have a clear link to the strategic plan of organizations. Strategy is also viewed as its implementation can be made possible by projects (Gray and Larson, 2006a). The accomplishment of strategy is mostly planned to meet the future needs of the organizations' customers so that the projects of those organizations should contribute value to their strategies. For example, a desired outcome could be fast time-to-market, high quality, and low-cost products (Milosevic, 2003; Milosevic and Srivannaboon, 2006). The organization can determine its strategic purposes such as the ability to deliver competitive products and provide services or the ability to support organizational processes through the following components (Cleland, 1998a).

Table 2: Modern project management's viewpoint

The components of strategic management to achieve the organization's purposes	Explanation
Organizational Design	It is "the alignment of people, specialized activities, and resources of the enterprise through a process of decentralization of authority, resources of the enterprise through a process of decentralization of authority, responsibility, and accountability (Cleland, 1998b)." Organizational designs use various structures such as organizational chart to "portrays the alignment of resources within the enterprise (Cleland, 1998b)."
Roles	Organization roles are "the individual and collective parts played by the members of the organization."

Table 2: Modern project management's viewpoint (cont.)

The components of strategic management to achieve the organization's purposes	Explanation
Style	The manager and follower style is "the manner in which knowledge, skills, and attitudes are expressed by the people who play roles in the company."
Supporting Systems	The supporting systems are "those associated with the organizational processes, such as manufacturing, finance, marketing, and R&D."
Resources	The resources are "the basis of the ability of companies to be successful and the bottom line of organizational performance."

A successful project is strategic in nature because when a project is planned, its concept should (Cleland, 1999):

- Contribute to the organizational objectives, goals, and mission
- Standard in the way that the project can be managed
- Handle the market and other environmental factors, which have an impact on the project and the organization.

There are two reasons why project managers need to understand strategy (Gray and Larson, 2006b). Those reasons are illustrated as follows:

1. Project managers can make appropriate decisions and adjustments
2. Project managers can be effective project advocates.

Those reasons support the needs for project managers to understand the strategic management. The strategic management is "the process through which organizations analyze and learn from the stakeholders inside and outside of the organization, establish strategic direction, create strategies that are intended to help achieve established goals and execute those strategies, all in an effort to satisfy key organizational stake holders (Harrison and St. John, 1998)." The strategic management process for project management is described in the following sequence and shown in figure 2-6 as a schematic of major activities required (Gray and Larson, 2002; Gray and Larson, 2005).

A. Review and defined the mission of the organization
B. Set long-range goals and objectives
C. Analyze and formulate strategies to reach objectives
D. Implement strategies through projects

PROJECT ANALYSIS

1. General Motors

General Motors in Asia has common processes across all four regions in General Motors. Units within each region implement local programs to enhance the model to fit business needs. GM had recently bought Saab and part of Fiat Auto and held stakes in three Japanese carmakers. Ford Motor Co. had looked at Daewoo and walked away. Now called GM

Daewoo Auto & Technology, the South Korean automaker has emerged as an engine for GM's fast-growing Asian operations. With its ability to turn out well-finished cars at low cost, Daewoo supplies GM with affordable cars for more than 150 markets around the world. GM has been pushed back by aggressive Asian rivals; it is a predator here in the Far East. Unfettered by legacy costs and image problems, GM is clawing market share from others. It expects its Asian operations, including Australia and India, to increase its regional market share by more than half, to 10 percent by 2010.

2. Ford

Ford has three best practices for project management. The first type of best practice is the Ford's executive sponsorship of an electrical/electronic systems engineering project management office. This office standardizes project management and engineering team that is aligned with the vehicle programs. It also acts as a single governance board for the project management office framework. The department's director, chief's and the electrical business planning and technology office participate in the governance board through weekly project management meetings to provide support and shift priorities as required.

Additionally, professional project managers consult on the implementation, execution and maintenance of the project management office as well as assisting with the transfer of project management knowledge for the organization. The electrical /electronic systems engineering departments has also internalized project management as a discipline in the engineering roles and responsibilities and provided training to the entire organization, with follow-up auditing processes in place for implemented projects. It has always been Ford's intent for engineers to develop competencies in the area and build an in-house project management discipline.
Transferring the leadership and ownership of project management from professional project managers to the engineering division is one of the recent changes in project management that Ford has implemented with positive results. This transfer has allowed further entrenching of the organization's goal of increasing project management maturity.

Ford Motor Co. differentiates between projects and programs. The electrical/electronic systems engineering project management office acts as the central project manager to standardize projects. The office engages defines projects that usually have a short frame with a clearly defined scope and clear allocation of resources. Whereas the whole organization focuses on program management, specific projects are managed as programs.

3. Hyundai

Hyundai has been making huge strides in quality improvement. In survey after survey, Hyundai has made important gains, impressing the industry and our owners alike. Did you know that Hyundai has over 900 engineers dedicated solely to quality? The support of talented and visionary suppliers is another key component. Hyundai major component of any project is quality assurance.

4. Toyota

There has been a change in Toyota Organizational structure since 1990s. The new organization is aimed at multi-project management. It has three vehicle development centers

in which multiple projects are grouped together, in contrast to either traditional single-project-oriented or function oriented organizations.

Toyota has often been considered a leader in adopting new organizational structures and managerial processes in both manufacturing and product development. Toyota production system, symbolized by its JIT and Kanban systems, has been targeted as one of the best practices in manufacturing by many firms, not only in automobile industry but also in other industries. With respect to product development organization, Toyota led in establishing a project-based management system, which aimed at coordinating activities in different functional areas into a well-integrated new product.

Many Japanese leading automobile companies and Toyota have been developing new product lines or replace existing products using their new and unique project management skills.
At Toyota, project management system that assigns too much autonomy to each product manager may concentrate too heavily on developing multiple new products through autonomous Project-oriented organizations. For example, Chrysler's project team approach, used LH and Neon Projects, might only appropriate for optimizing the development of one product at a time. In contrast, Toyota managers have considered that a project team approach is not an efficient way for large firms to develop many products concurrently that could share similar technologies and components.

Asian automobile firms started changing around 1995. There were two interrelated issues. First, rapid growth in production levels at the Japanese firms virtually ended. The aggressive product strategy of Japanese automobile firms in the 1980's, such as frequent new product introductions and replacements, had been partially based on their assumption of continuous rapid growth. The new environment seemed to require some changes in strategy, as well as in company organizations. Second, the importance of cost reduction became even more critical for international competition than before. In addition to the appreciation of the yen, Japanese advantages in development and manufacturing productivity have been diminishing. Both factors have had a strong negative impact on the cost advantages they had been enjoying.

5. Honda

Honda has a reputation for innovative product designs and advanced engine technology. The reputation has required an effective mix of project management skills and functional skills in engine R&D. With regard to project management, Honda tends to assign most engineers full time to specific product teams. In contrast, at other Japanese firms and at most other firms and at most other auto makers in Europe and United States, component engineers usually take responsibility for two or three vehicle projects at the same time. Spreading technical expertise across multiple project is one of the major characteristics of a matrix organization, as opposed to independent product or project teams, such as Chrysler's. When it starts work on a new product, Honda forms a temporary project team that resembles a task force of engineers from different functional areas.

Honda does have strong managers, which it calls Large Project Leaders(LPLs).Although top management has slightly reduced their authority in recent years ,the LPLs are still more powerful than project managers in traditional matrix organizations such as Renault and Mitsubishi. Therefore, they have been really close to the ideal heavyweight project manager.

INTERVIEW ANALYSIS

1. Interview Analysis from Project Manager from General Motors

The interview helped to mark some standards and the project management strategies the general motors have used and tend to implement in Asian market. GM is currently in the implementation phase of several critical projects. Their strategy allows them to move closer to global systems, and help them eliminate additional unique systems and reducing cost. Their project management team which is hired from all over the globe to meet the competitive Markey globally and establish its standing in Asian market develops a semi-annual check to enhance the ordering/selling of the vehicle.

General Motors project management office trains its manufacturing unit executives to have an aggressive plan of continuing training the people in each division of the unit. The Pm team makes sure that each person has technical skill enhancement plan which the company needs to complete. The project management team also has been focusing on Structural cost reduction IN Asian manufacturing units for their cars. Project Management team in General motors portrays a never-ending focus on I/T organization-not just internally ,but how can they, I/T ,help the business be more efficient, productive and responsive.

One very important strategic change that Asian GM is looking for is Globalization. They want to maintain the agility to leverage GM'S globalization and take advantage of opportunities as quick as possible in the Chinese, Japanese and Indian markets. General motor project management team has come up with third generation model of me I/T sourcing, so that they can effectively manage new suppliers and foster their partnerships in Asia.

The manager also explained how the company was striving to achieve growth and more success in their future venture. The manager also shared their top priority list strategic changes and tools for their current management. They want to drive revenue growth .Due to the weak market, they are go in to emphasize the extent of the challenges the company makes and translate their improvements in products quality and manufacturing into better financial results. They plan to cut almost $9 million in fixed costs through plant consolidation.

2. Interview Analysis from Team Manager from Honda

The team Manager shared more of a general view rather than any particular project details. This has been Honda's common dialogue by reaching the public in a common manner instead of generalization. The team manger informed that the project management group in their company often are maintained and run by the top executive .Except the manufacturing plants and marketing the projects are managed by top executives which act as a project manager. The Project Management and the strategic planning team recently viewed various changes around them due to the continuous Asian car competitive market. Asia has seen a never before competition by massive and small sized company in the previous years.

Manager very deeply explained the project management group which is trying to continue to develop the growth opportunity in China and India. These are the two most fast growing car industry markets in Asia currently. The Asian Honda PM team is trying to collaborate

themselves with Brazil, UK to get the best available tools and methods to perform the right activities and grow rapidly.

The management team has attracted various young members and retained the old ones.

The content management team is planning to develop internal systems that can facilitate the acquisition, management and control of all technical content and intellectual property. The meetings held in Honda for Project managers and team managers, project light and expand the offerings of SAE meetings and conferences outside Asia. In Honda the team manager mentioned that engineers are the winners and the project manager is the guidance to their success. Honda project management tools do an about-face on everything from decision-making to design. Honda is one of the Auto companies in Asia showing a profit. Honda team manager says it is determined to maintain its presence in Asia -- awaiting the accomplishment of various new tools and technical approaches used by Project Managers. The company bought out its Thai partners, taking a 93% stake in the company. It is relatively easy for Honda to change its mind, unlike other Asian companies, such as Nissan or Mitsubishi Motors. Its manufacturing line is flexible. The number of platforms is small. In the case of the Accord, Honda has only one platform, but five lines. Production is different in each market. This level of flexibility is quite unique.

3. Interview Analysis from Executive from Toyota

The executive from Toyota India gave some insight on the company's past and current corporate plans and the development which will take place in Toyota by its Program Managers.

The executive before being interviewed that all their company strategies related to the idea" Toyota does: building quality, reliable cars with good value and taking care of customers". He was keen on making us understand the need of newer techniques and certified PMs in Toyota in Asian centers. Toyota's program managers are focusing more on the business plans at the moment. He also stressed on the fact that their company makes every quarter a milestone instead of a year. The executive was very enthusiastic on mentioning their success of surpassing General Motors in the world last year in April. Toyota as a company continues to grow and expands our footprint; it is more incumbent on us to re-double our efforts to improve the things that got them at this peak.

The project management team has worked hard towards quality ,efficiencies getting better, cost-saving efforts, innovation and technology investments pay off and have been able to cycle those into production...customer service at the dealership improves. All the things that are the factors of success continue to become more important as you the company gets bigger.

Toyota is not in a state of constantly confronting problems and changing directions but is executing a strategy and plans that have been envisioned in the past. The approach the company takes is a more conservative decision-making process that tries to avoid wrong decisions and therefore it takes longer to make decisions. But once a decision is made, the quality is better and the organization is aligned with it. Execution is then painless, quick and accurate. Ten years ago, the company made a significant change by investing in hybrids and

fuel-efficient vehicles. Nobody else did it or was doing it. That has really paid off the last couple of years. They made the change not in a crisis or because of a problem but because it was the appropriate time and the future dictated that for good business. Toyota has grown globally and become a global organization and is deriving the bulk of the volume no longer in Japan.

4. Interview Analysis from Chief Manager from Suzuki

Chief Manager of engineering department was interviewed to pour some light on the insights and ongoing projects in the company. He clarified that unlike rumors Suzuki had a very strong project management cell and which is in accordance to the company's organizational objective. The manger talked about the initiative it has taken in the Asian market.
At Suzuki Japan, young recruits are never put in the shop floor straightaway to handle production and workers because this is a job they would be least fit to do with their level of maturity. On the other hand, they would be fit to do technical related work because they would have just come out of engineering colleges. They come with fresh minds and they are given fresh projects.

Rapid product development using concurrent engineering is our next best practice wherein the lead-time is shortened. Suzuki has have also adopted TQC and TQM practices. Our growth since 1990 can be attributed to the TQM approach. TQM basically has three aspects. It is a system of excellence to sustain the best results through the best process. Respect for people is the other component of TQM. Right from the level of the workmen, we have various forums for employees to participate in self-improvement activities. We have suggestion schemes, quality circles, cross- functional teams, and supervisory improvement.
Suzuki has a skill matrix for engineers and managers. Based on it, they identify training needs of their engineers in a project. They prepare modules, some of which are also provided by overseas and indigenous faculty. The top two quality circles are sent to Japan, Singapore, and Thailand to participate in the QC conventions there. The candidates are then sent to auto fairs in Europe. Training is also provided at Suzuki. Suzuki is one of the most reliable sources of automobile engineers and technical team projects to come from Japan.
Suzuki has been the center source of product for middle size market. It has mostly very affordable cars. The engineering manager stressed on the fact that the company was trying to figure out new strategies to mend their team in such a manner that they can compete with the higher end car sat a lower price.

5. Interview Analysis from Senior Manager from Hyundai

Hyundai Motor is pursuing a policy of global expansion. Its current objective in the Asian car manufacturing market is to win over car buyers in the world's biggest market is crucial to the company's hopes of building a globally recognized brand. The executive explained their strategy for breaking into the industry's top five by 2011 .The Company relies on a rapid buildup in two of the world's fast-growing markets: China and India. According the senior executive their vice president recently declared "The Company's resources will be focused on expanding our presence in emerging markets this year."

Hyundai very important project Management strategy which is being used in almost all its projects is to identify the changing technology strategy of Asian companies in response to

changing business/technology such. Hyundai is hiring special Project Manager to mark its name in the big market effectively. Hyundai till now has hired more than 60 exclusive project managers to assist their venture for next two years. Hyundai Is collaborating with external Project management allocators like it did in 2004 to expand its scope and get more knowledgeable about newer methods and a strong project management team.

RECOGNIZED STRATEGIES

1. Collaboration

Companies in Asia have collaborated their Project management resources and other teams to get better exposure and more perfect tools to enhance their strategies in Asia and go global. A company like Toyota Motor Corp. developed long-standing social and economic relations with a network of suppliers. Higher levels of trust and less fear of opportunistic behavior than was normal in the U.S. characterized both sides of these relations. Toyota relied far less on formal contracts than a company like General Motors Corp. (GM). The result was that Toyota and its suppliers felt able to undertake more joint development work, to exchange sensitive potentially vulnerable information, and to operate a tighter just-in-time component delivery system. A further illustration of the positive contribution trust makes concerns knowledge creation through intercultural teams. Each team was composed of members who came from different national units, either within a multinational corporation or its alliance network. Five of the six teams were operating from the outset within a formal (contracted) context; their members also came from middle hierarchical levels (such as senior engineer).
Honda also developed a similar collaboration with a Europe based company for cost effective management. The Program managers at Honda researched and found the most suitable model for their company and hired the Europe base company for this purpose. Honda's cost-modeling process extends well beyond simply determining the cost of a part or component. It is an integrated process that takes into consideration every factor that contributes to the total cost.

2. Green Business Strategy

More companies are leading the charge to develop and invest in environmentally friendly technology -- not just because its good for nature, but it's also good for the bottom line. Honda and Toyota, rocket along with soaring oil prices, and this has force them to respond quickly and make some major changes in their projects. Ford has already brought technology from Toyota for its Explorer SUV hybrid. Hyundai in Asia have projects ready for hybrid cars. The project Management teams in various companies have trained themselves in the green manner and differentiating the option in the project which are not sustainable to the environment.

3. Expansion

GM has signed a framework pact for the sale and export of approximately USD $1 billion worth of vehicles, components, machinery and equipment to our flagship joint venture in China. Meanwhile, Ford has signed a similar deal worth more than USD $800 million. That deal includes the sale of more than 30,000 North American-built vehicles to China starting from 2009. Additionally the blue oval will sell transmission components and parts (starting

this year) to its joint venture in China. Not to be outdone, Toyota has announced plans to build a second production line in China, which will cost $380 million in investments. The new production line will build more Toyota Camry.

4. International Market place

General Motors, Ford Motor Company, and Chrysler Corp. (now part of DaimlerChrysler following its merger with Daimler-Benz AG) – accounted for 68% of the passenger cars produced in the United States in 1997. The remaining 32% of U.S.-made cars came from Asian and European "transplant" firms. Along with these giant assemblers, the automotive commodity chain also includes parts manufacturers. The auto parts industry is fragmented, consisting of thousands of suppliers ranging in size from small shops to large multinationals. The auto parts segment of the chain is divided between original equipment manufacturers (OEMs) and the replacement market.

5. Supplier Based Technology

Selection of supplier based on technology has become important for the project management offices for manufacturer whose focus is on product and launch flexibility. However, quality becomes strategically important when the manufacturer is focusing on volume flexibility. Inventory management and technology roadmap are very important project management strategies with robust influence on all three forms of manufacturing flexibilities, namely product flexibility, launch flexibility, and volume flexibility. In sum, the manufacturer needs to understand clearly which flexibility of its operation is required, and then adopt a working supplier selection and management strategy.

CONCLUSION

1. A number of project management tools/templates have been developed, however there are no documented processes around how and when to use them.

Result: Utilization of project management tools is not consistent.

2. There is no structure or unified approach to the management of team projects:
Individual project managers within the department apply different approaches to the overall management of their projects (i.e., everyone has a different method of working). Project managers have had to learn how to "work around" each other. A number of Project Management (PM) processes, such as risk management, issues management, and project staffing, are performed on an informal basis.
Project schedules are maintained by project managers on an individual basis (i.e., "off-line).

Result:
1. Project management processes are not consistent or repeatable across team projects.
2. Little or no opportunity for information sharing/learning between project managers/teams.
3. Extremely low probability of configuring the Project Management Office (PMO) to effectively and efficiently support the organization's project community

3. There are several types or categories of project plans implemented within the department that serve differing company objectives.

Result: Several off shoot plans are being created to accommodate cross project reporting and dependency management.

4. Project managers within the new business team are forced to wear many hats (i.e., project manager, technical lead, as well as ongoing maintenance and operations responsibilities).

Result: Many projects are not completed in a timely manner. No distinguishable difference in approach to "project" work vs. "day-to-day" operations.

5. A number of "individual" project management challenges were also identified:

Project Management Challenges/Pain Points

1. No existing templates to provide adequate guidance: How and when to use them, where to access them, how to complete them, etc.
2. There is no way to identify the availability of department resources for project work.
3. Business owners set unrealistic time-frames for completing projects. There is no realistic validation of date.
4. Individual project managers within the department do not know what other project managers are working on, making it difficult to identify and support the information requirements of other projects.
5. Current project management tools and templates are not centralized. Impossible to create a complete end-to-end project plan.
6. Project prioritization process unclear, making it difficult to determine which projects to focus on and apply resources to.
7. Individual project managers do not follow the same project management process.

Assessment

Projects should be segmented across functional groups within the organization. Each function should develop "Project Plans" for its own work independent of other functions and thus no end-to-end project plans should exist. To help alleviate this problem a system of milestone "hand-offs" should be developed to identify the cross function work dependencies. This however, can necessitate the need for a consolidated master milestone plan that requires additional effort to support and maintain.

While most of the approaches taken by the team's project managers are implemented out of a need to "get the job done", they are indicative of an organization with no structured approach to executing projects. This has led to inconsistencies and inefficiencies across the organization.

It is possible to address each of these findings on an individual basis and develop individual project team solutions. However, such an approach, without consideration of the enterprise as a whole, will lead to minimal success with mediocre results .In Asia ,such an approach is

very common ,many car companies fall in this pit unknowingly .Thus, newer strategies can resolve this problem.

These issues are really symptomatic of a larger issue within the organization. There is no formal recognition of "Project Management" as a viable management concept. It is at best an afterthought, and not seen, nor used as an effective management concept. Though no fault of the organization, this is indicative of an immature project management organization.

Value Proposition

The ability of a car company business to succeed is driven by it's effectiveness in implementing strategic change in a rapidly changing environment. Asia has a very rapid dynamic environment. The competition has to be dealt with a lot of vision. Developing an organizational project management framework for the systematic management of projects, programs and portfolios in alignment with the organizations strategic goals is a proven means of implementing strategic change and achieving business success.

Implementing organizational project management involves embedding skills, knowledge, process, tools and organizational structures within an organization to support this framework to deliver strategic change. An organization's effectiveness in delivering business strategy can therefore be called its organizational project management capability. Most organizations are at a low level of maturity. Building this maturity iteratively is the key to more effectively delivering the organization's strategy.

Project management technology is a major component in enabling project management capability. It provides a means of automating the analysis of project scope, cost and time, and the complexities of managing this across multiple projects. Any technology implementation needs to assess the business processes that will be required to support it, the skills and knowledge that needs to be in place within the user base, and what organizational changes are necessary. All this needs to be in line with the organizations project management maturity. Focusing on the technology leads to trying to leapfrog maturity levels, and the associated cultural challenges that come with this.

Lack of project management adoption is typical because the organization tried to implement toolset functionality that required a higher level of maturity than the organization was actually at. An organizational project management toolset should be deployed at an appropriate level of maturity, and be capable of evolving over time in line with your processes and people.

To achieve increasing levels of project management capability it requires greater sophistication in terms of tool usage, and therefore increasing maturity in terms of processes and people in place. When it comes to implementing project management technology it is important is to walk, skip then run.

Recommendation

Based on the findings outlined above:
In order to add value to the organization, project management must support the team in the achievement of its corporate objectives. Project management strategies provide this support by ensuring that the company pursues, and effectively manages; only the projects that contribute to the attainment of their goals and strategies. This level of Value-Added Project Management can only be attained within the business through the implementation of a structured Project Portfolio Management (PPM) Program. Effective implementation of a structured PPM Program, in turn, can only be accomplished through a strategically functioning PMO. Thus, the PMO serves as the mechanism or conduit through which a structured PPM Program is established and maintained within the organization.

To this end, a three phase approach to creating a strategically positioned PMO that will be used to develop and implement a structured PPM Program for the organization.

Phase 1. Develop Project Management Strategy for Your Organization - The objective of this Phase is to identify goals and strategies and define Project Management objectives based on the company's goals and strategies and demographic location. A Project Management Sponsor should be identified to drive the overall development and implementation of the Project Management objectives. A Project Management Governance Committee should be created to ensure that the PPM Program developed achieves its established Project Management objectives.

Phase 2. Create a Project Management Office (PMO) for PPM Program - The goal of this Phase is to determine the level of maturity required of the PMO to achieve your Project Management Objectives. Establish the charter for the PMO and to setup and staff the PMO.

Phase 3. Develop and Implement the PPM Program - The intent of this Phase is to assess the team against its required level of maturity identified in Phase 2 and establish a baseline.

Future Research

The further study could extend the finding to other regions of car companies. The comparison between Asian car companies and European car companies can be the interesting topic. The role of foreign car companies playing in domestics markets can also be the valuable study.

ACKNOWLEDGEMENT

The authors would like to thank Faculty of Business Administration at Kasetsart University for financial support in this research. We also would like to acknowledge our thanks to the anonymous reviewers for their valuable comments.

REFERENCES

1. Cleland, D.I. (1998a), 'Strategic project management', in JK Pinto (ed), *The Project Management Institute Project Management Handbook*, Jossey-Bass, San Francisco, CA, pp. pp. 27-54.
2. Cleland, D.I. (1998b), 'Strategic project management', in JK Pinto (ed), *Project Management Handbook*, Jossey-Bass, San Francisco, CA, pp. pp. 27-54.
3. Cleland, D.I. (1999), *Project management: strategic design and implementation,* 3rd edn, McGraw-Hill, New York, NY.
4. Gray, C.F. and Larson, E. (2002), *Project management : the complete guide for every manager,* McGraw-Hill, New York.
5. Gray, C.F. and Larson, E.W. (2005), 'Project Management: The Managerial Process', 3 edn, McGraw-Hill Publishing, New York, NY, pp. 66-67.
6. Gray, C.F. and Larson, E.W. (2006a), *Project management : The managerial process,* 3rd edn, McGraw-Hill/Irwin, Boston.
7. Gray, C.F. and Larson, E.W. (2006b), *Project management: The managerial process,* 3rd edn, McGraw-Hill/Irwin, Boston, MA.
8. Harrison, J.S. and St. John, C.H. (1998), *Strategic management of organizations and stakeholders: Concepts and cases,* 2nd edn, South-Western College Publishing, Cincinnati, Ohio.
9. Institute, P.M. (2004), *A Guide to Project Management Body of Knowledge,* 3rd edn, Project Management Institute (PMI) Publishing, Newtown Square, PA.
10. Meredith, J.R. and Mantel, J.S.J. (2006), *Project Management: A Managerial Approach,* 6 th edn, John Wiley & Sons, Inc., NJ.
11. Milosevic, D.Z. (2003), *Project Management Toolbox: Tools and Techniques for the Practicing Project Manager,* John Wiley & Sons, Hoboken, New Jersey.
12. Milosevic, D.Z. and Srivannaboon, S. (2006), "A theoretical framework for aligning project management with business strategy", *Project Management Journal,* vol. 37, no. 3, pp. 98-110.
13. Nicholas, J.M. (1990), *Managing Business and Engineering Projects: Concepts and Implementation,* Prentice-Hall, Inc., Upper Saddle River, NJ.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

STRATEGIC INFORMATION AND CUSTOMER-ORIENTED SYSTEMS: THE ROLE OF COMPETITIVE PRIORITIES

Oscar F. Bustinza, University of Granada, Spain
Email: oscarfb@ugr.es

Daniel Arias-Aranda, University of Granada, Spain
Email: darias@ugr.es

Vanesa Barrales-Molina, University of Granada, Spain
Email: vanesabm@ugr.es

ABSTRACT

Purpose: *The analysis of key business variables and support decisions to facilitate the Information Systems (IS) are essential tools available to organizations to manage their decision making policies. In this sense, this article examines how the implementation of information systems (IS) management and customer relationship (CRM) affects the customer's competitive strategy and business performance.*
Design/methodology/approach: *A survey is used to collect data. Empirical analysis utilises Structural Equation Modelling (SEM).*
Findings: *The main findings show a significant positive relationship between integration and skills developed by IS and competitive priorities related to flexibility, innovation and time. Similarly, it is found that the integration of SI is positively and directly related to the customer results while the relationship between the skills developed by SI are positively but indirectly related to these results, being the mediator of the relationship above competitive priorities.*
Originality/value: *The conclusions obtained clarify the role of resources and capabilities generated by IS in organizations, extending the analysis of field theories like Resource-based and Knowledge-based view of the firm in this area.*

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

PERCEIVED RISKS AND RISK REDUCTION STRATEGIES IN ONLINE GROUP-BUYING

Fei-Fei Cheng, Institute of Technology Management National Chung Hsing University, Taiwan R.O.C.
E-mail: feifei.mis@gmail.com

Tien-Yin Liu, Institute of Technology Management National Chung Hsing University, Taiwan R.O.C.,
E-mail: lalazax@hotmail.com

Chin-Shan Wu, Department of Information ManagementTunghai University, Taiwan, ROC.
E-mail: cswu.mis@gmail.com

ABSTRACT

Purpose: *The purpose of this research is to examine the relationship between risk perceptions (financial, performance, social, time and privacy risks) and risk reduction strategies (brand loyalty, word of mouth, past experience, money back guarantee, store image, shopping, major brand image, free sample, website reputation, and payment security) in online group buying context.*
Design/methodology/approach: *A questionnaire survey was conducted in campus. There are 212 questionnaires were received, and 198 of them are valid.*
Findings: *The results from current study suggested that when subjects perceived financial risk, the brand loyalty, word of mouth, money back guarantee, website reputation and payment system will be adopted to reduce the risk. In addition, performance risk is related to brand loyalty, word of mouth, money back guarantee, major brand image and free sample. Time risk is related to shopping and website reputation, while privacy risk has significant correlation with shopping. There are no risk-reduction strategies related to social risk. Thus, the practitioner have to try some other ways to reduce social risk.*
Practical implications: *Results from current study provide useful knowledge to help the operators who are running online group business in understanding useful strategies to reduce different risks perceived by their potential customers. For example, building strong brands and store image, encourage consumers to spread positive word of mouth are useful ways to mitigate consumers' concern about the performance of the product/service.*
Originality/value: *Online group-buying is one of the fasted growing business model. However, knowledge regarding consumers' concern and possible ways to relief the perceived risks in online group-buying context are limited. Results from current study can contribute to the field by illustrating the useful strategies the e-vendors can use to reduce possible concerns.*

Keywords: Online group-buying, perceived risk, risk reduction strategy, e-commerce

INTRODUCTION

With the popularity of the internet, online shopping has become one of the most important shopping patterns. In addition, group-buying as a new business model also grows fast in recent years. In Taiwan, only 11% of users use online group-buying in 2009, but the number doubled to 22.3% in 2010. However, although online group-buying grows rapidly, complaints have also increased, Popular consumer disputes about online group-buying include: (1) restaurants claim the seats are full, unable to reserve, or even there has seat but still not accept who has coupon purchased from online group-buying website; (2) the restaurants do not indicate the consumption restrictions (such as meals cannot enjoy a free supply of ice cream); (3) actual product served or price compare to the information post on the group-buying site is different. It reveals that a transaction via group-buying site is convenient, but also involves lots of perceived risks and unexpected consequences. Thus, it is important for group-buying marketers to understand how to adopt different risk-reduction strategies to relief consumers' potential perceived risks. The objective of current study is to examine the relationship between perceived risks and risk-reduction strategies to understand how to reduce which perceived risk by using which reduction strategy in online group-buying context.

LITERATURE REVIEW

Online Group Buying

Online group buying was introduced in the mid-1990s, as a market mechanism that collects consumers' orders to obtain volume discounts (Kannan & Kopalle, 2001). This mechanism not only benefits consumers but vendors. Due to more people lower price, consumers have incentive to recruit more customers, so that internet vendors will be able to minimize consumer acquisition costs at the same time to offload excess inventories (Kauffman & Wang, 2001). Anand and Aron (2003) considered online group buying is composed of demand aggregation and quantity discounts, more demand more discounts, let consumer get better condition to purchase. Yuan and Lin (2004) considered online group-buying use time to exchange money, more quantity lower price, buyers have coordination abilities with vendors to achieve price discount which they want, but at the same time waiting for other buyers. Thus, the goal of online group-buying is to create a win–win situation between vendors and consumers, so as to maximize the aggregate social welfare by making each party better than they would be in the absence of this mechanism (Kauffman, Lai, & Ho, 2010).

Perceived Risk

Since the 1960s, the theory of perceived risk has been used to explain consumers' behavior. Bauer (1960) is the first one that developed perceived risk from psychology theory. According to Bauer (1960), consumers' behavior involved risk because their purchasing actions ''will produce consequences which he cannot anticipate with anything approximating certainty, and some of which at least are likely to be unpleasant''.

Cox (1967) proposed the perception that consumer get from the buying action is related to "Financial" or" Social-psychological". Woodside(1968) considered perceived risk has three dimensions: "Social", "Functional" and "Economic". In addition, Roselius (1971) indicated consumer might suffer time loss, hazard loss, ego loss and money loss. Jacoby and Kaplan

(1972) added financial risk and physical risk, proposed five type of perceived risks: financial risk; functional or performance risk; physical risk; psychological risk; and social risk.

Consumers are easier to perceive risks when shopping online than in physical store (Akaah & Korgaonkar, 1988; Tan, 1999). The reason might be that online group-buying can't sure that all shopping objects and condition would be completely success and finish, therefore, consumer will face financial risk, performance risk, psychological risk, physical risk, social risk and time risk. For online shopping, the major concern for consumer is network security and information privacy problem (Miyazaki & Fernandez, 2001). To sum up, in online group-buying environment, consumers may face seven risks, which include financial risk, performance risk, social risk, time risk, and privacy risk.

Risk-Reduction Strategies

Roselius (1971) proposed eleven strategies that consumers used to reduce risks regarding time loss, hazard loss, ego loss, and money loss. The strategies include endorsements, brand loyalty, major brand image, private testing, store image, free sample, money back guarantee, government testing, shopping, expensive model, and word of mouth. Derbaix (1983) fixates on the relationship between nine kinds of risk-reduction strategies (Money-back guarantee, Store Image, Advice of friends and relatives, Salesman's advice, Expert advice, Brand loyalty, Major Brand Image, Shopping, and Expensive mode) and different perceived risks. Akaah and Korgaonkar (1988) focus their research on direct-mail marketing, they use conjoint investigation to analyze the relative importance of the eight kinds of risk-reduction strategies in consumers' mind, the conclusion is that "Money-back guarantee" is the most essential strategy, and then are "Manufacturer's name ", "Product cost", "Distributor's reputation", Free sample/trial", "Endorsement by a trusted person", "Brand experience" and "Product newness".

Mitchell and Greatorex (1993) combined risk-reduction strategies suggested by Roselius (1971), Guseman, and Derbaix (1983) and proposed 14 strategies to reduce the risk of purchasing service: (1) trying the product/service before purchase; (2) reading advertising material about the product/service; (3) reading consumer guides; (4) choosing a cheaper product/service; (5) choosing a brand/supplier of the product/service which is well known or popular; (6) purchasing the same brand of the product or using the same supplier of the service that you purchased/used before, i.e. be brand loyal; (7) using the image of the product/service as a guide; (8) ensuring the product/service has some form of guarantee, (9) shopping around to compare what is on offer; (10) choosing a more expensive product/service; (11) favoring the products/services which are endorsed by a celebrity; (12) taking the advice of family and friends; (13) choosing a product/service which is subject to some sales promotion; (14) taking the advice of the sales assistant.

RESEARCH METHOD

Research Method

The purpose of this study is to explore the relationship between perceived risks and risk-reduction strategies in online group-buying environment. The perceived risks examined in this study include financial, performance, social, time and privacy risks. In order to choose appropriate risk-reduction strategies in current study, a pilot test was conducted. The result

suggested ten popular strategies in online group-buying context: brand loyalty, word of mouth, past experience, money back guarantee, store image, shopping, major brand image, free sample, website reputation, and payment security.

Operational Definition and Measurements

The operational definition and measurement of each variable was summarized in Table 1 and Table 2.

Table 1. Definitions of perceived risks

Perceived Risks	Operational Definition	Reference Source
Financial risk	Financial loss of consumers, including defect product, extra expense after purchase and the possibility of Internet hackers to steal credit card information.	(Cases, 2002; Forsythe & Shi, 2003; Lim, 2003)
Performance risk	The product is not as expect or does not match with the seller's description.	(Cases, 2002; Forsythe & Shi, 2003; Grewal, Gotlieb, & Marmorstein, 1994)
Social risk	Products purchased by consumers may lead others laugh.	(Featherman & Pavlou, 2003; Pires, Stanton, & Eckford, 2004)
Time risk	Waste time to exchange the defect product, too slow the web page download speed and the seller respondent	(Featherman & Pavlou, 2003; Lim, 2003; Tan, 1999)
Privacy risk	Personal information be stolen, resold or leak out.	(Cases, 2002; Forsythe & Shi, 2003; Lim, 2003)

The measurement of perceived risks was adopted from Peter & Tarpey (1975). Each subject was asked to provide the possibility and importance of each risk that might occur in online group-buying. The seven point scale was used in which 1 represent very impossible/the least important, while 7 represent very possible/very important.

Table 2. Definitions of risk reduction strategies

Risk reduction strategies	Operational Definition	Reference Source
Brand loyalty	Buy the brand you have used before and have been satisfied with in the past.	(Roselius, 1971)
Word of mouth	Ask friends or family for advice about the product.	(Roselius, 1971)
Past experience	Relying on past personal experience	(Cases, 2002)
Major brand image	Buy a major, well-known brand of the product, and rely on reputation of the brand.	(Roselius, 1971)
Free sample	Use a free sample of the product on a trial basis before buying.	(Roselius, 1971)
Shopping	Shop around on your own and compare product features on several brands in several stores.	(Roselius, 1971)

Money back guarantee	Buy whichever brand offers a money-back guarantee with the product.	(Roselius, 1971)
Store image	Buy the brand that is carried by a store which you think is dependable, and rely on reputation of the store.	(Roselius, 1971)
Website reputation	The reputation of the website.	(Cases, 2002)
Payment security	Payment process has guarantee.	(Cases, 2002)

This research uses five point scale to measure the risk reduction strategies. One indicate very not helpful and 5 indicate very helpful. The same scale was also used by Cases (2002), Mitchell and Greatorex (1993) and Roselius (1971).

Sample Collection

A questionnaire survey was conducted in campus. Before the subjects agreed to participate, a brief explanation was provided. Every subjects will fill in the questionnaire after they understand the purpose the study and agree to join. About 10% of the subjects were pull out from a lucky draw and were provided with a small gift as the incentive. There are 212 questionnaire were received, and 198 of them are valid.

RESULTS AND DISCUSSION

Demographic

The subjects were composed by 53.5 % males and 46.5% females. The majority of the subjects are undergraduate students (83.8%), followed by graduate students (16.2%). They ages mainly around 15-19 (52.0%) and 20-24 (47.5%) years old.

The Correlations between Perceived Risks and Risk- Reduction Strategies

Pearson correlation analysis was conducted to examine the relationship between perceived risks and risk reduction strategies. The result indicated that financial risk is related to money back guarantee, store image and payment security; while performance risk is related to brand loyalty, word of mouth, money back guarantee, major brand image and free sample. Time risk is related to shopping and website reputation, while privacy risk has significant correlation with shopping. There is no risk-reductions related to social risk.

Table 3: The Pearson correlation analysis of perceived risks and risk reduction strategies.

	Financial	Performance	Social	Time	Privacy
Brand loyalty	.008	.151*	.030	.062	.029
Word of mouth	.121	.146*	-.058	.078	.136
Past experience	.049	.035	-.112	-.043	.054
Money back guarantee	.200**	.174*	-.001	.062	.126
Store image	.174*	.204**	-.069	.045	.126
Shopping	.055	.099	.035	.207**	.153*
Major brand image	-.059	-.153*	-.008	.048	-.030
Free sample	.125	.180*	-.070	-.039	.100
Website reputation	.121	.094	-.030	.141*	.135
Payment security	.140*	.032	-.030	.121	.101

CONCLUSION

The results from current study suggested that when subjects perceived financial risk, brand loyalty, word of mouth, money back guarantee, website reputation and payment system will be adopted to reduce the risk. Derbaix (1983) found out when it comes to financial risk, consumers more likely seem brand loyalty, money-back guarantee, store image and shopping as the most critical strategy. Brand loyalty and money back guarantee is consistent with the results of this study. Van den Poel & Leunis (1999) also indicate money back guarantee ranks highest for both financial and performance risk but especially so with respect to reducing financial risk. People who concern about the product is not as expect, tend to release the risk by brand loyalty, word of mouth, store image and shopping. Lutz & Reilly (1973) said consumers tend to use more sources of information when faced with increasing degrees of perceived performance risk. Physical risk, worried about the health will be injured, shopping and free sample are helpful. Derbaix (1983), shopping is the most efficient way to decrease the psychosociological risk; except shopping, this study find out the psychological pressure from group-buying can ease by money back guarantee, free sample, website reputation and payment security. Time risk, by website reputation to infer the possibility of receive defective product is relatively low, therefore, needless to wait for replacement time. For privacy risk, word of mouth and website reputation can confirm website security, observe each shop's privacy strategy during shopping and payment security that claim personal information will not leak out, there strategies can reduce privacy risk.

CONTRIBUTIONS

If consumers would like to obtain more product information or verify the accuracy of the information from multiple sources, they often refer to the opinions of friends and relatives who purchased the same products or rely on shopping strategy, then compare the contents and qualities of different offerings. Therefore, vendors should act with honesty and provide detailed information as much as they can in order to avoid the concerns and complaints which make by consumers that will hurt the reputation the companies had tried very hard to establish.

Highly concerned about the possibility of the leakage of their personal data due to online group-buying and such worries may affect their purchase intention. Therefore, vendors should take heed of the proper protection of personal data of consumers and assurance of transaction security so as to reduce the perceived risks.
In order to reduce the waiting time and increase the purchase intention, vendors are suggested to have powerful search and navigation, quality and detailed product information, rapid response, simple and safe payment system and build up good reputation to attract more consumers.

Consumers are worried about all kinds of unexpected situations after the purchase of products and fear that their rights will be affected. Therefore, they are likely to choose the vendors with good reputation or have warranty because they believe that the better these vendors have been, the more experienced they are in handling unexpected situations or more adopt in risk preventions. Therefore, the vendors should strive to provide solutions to all kinds of unexpected situations in order to obtain the recognition from consumers for the quality of products.

ACKNOWLEDGEMENT

Funding of this research work is supported by the National Science Council (grant number, NSC 100-2410-H-005 -002 -MY2), Taiwan.

REFERENCES

1. Akaah, I. P., & Korgaonkar, P. K., 1988. A conjoint investigation of the relative importance of risk relievers in direct marketing. Journal of Advertising Research. 28(4), 38-44.
2. Anand, K. S., & Aron, R., 2003. Group buying on the web: A comparison of price-discovery mechanisms. Management Science. 49(11), 1546-1562.
3. Bauer, R. (1960). Consumer behavior as risk taking. In R. S. Hancock (Ed.), *Dynamic marketing for a changing world* (pp. 389-398). Chicago: American Marketing Association.
4. Cases, A.-S., 2002. Perceived risk and risk-reduction strategies in internet shopping. International Review of Retail, Distribution & Consumer Research. 12(4), 375-394.
5. Cox, D. F. (1967). *Risk taking and information handling in consumer behavior*. Boston: Harvard University.
6. Derbaix, C., 1983. Perceived risk and risk relievers: An empirical investigation. J. Econ. Psych. 3(1), 19-38.
7. Featherman, M. S., & Pavlou, P. A., 2003. Predicting e-services adoption: A perceived risk facets perspective. International Journal of Human-Computer Studies. 59(4), 451-474.
8. Forsythe, S. M., & Shi, B., 2003. Consumer patronage and risk perceptions in internet shopping. Journal of Business Research. 56(11), 867-875.
9. Grewal, D., Gotlieb, J., & Marmorstein, H., 1994. The moderating effects of message framing and source credibility on the price-perceived risk relationship. J. Consum. Res. 21(1), 145-153.
10. Guseman, D. S., Risk perception and risk reduction in consumer services.
11. Jacoby, J., & Kaplan, L. B. (1972). *The components of perceived risk.* Paper presented at the Third Annual Conference of Association for Consumer Research, College Park.
12. Kannan, P. K., & Kopalle, P. K., 2001. Dynamic pricing on the internet: Importance and implications for consumer behavior. International Journal of Electronic Commerce. 5(3), 63-83.
13. Kauffman, R. J., Lai, H., & Ho, C.-T., 2010. Incentive mechanisms, fairness and participation in online group-buying auctions. Electronic Commerce Research and Applications. 9(3), 249-262.
14. Kauffman, R. J., & Wang, B., 2001. New buyers' arrival under dynamic pricing market microstructure: The case of group-buying discounts on the internet. Journal of Management Information Systems. 18(2), 157-188.
15. Lim, N., 2003. Consumers' perceived risk: Sources versus consequences. Electronic Commerce Research and Applications. 2(3), 216-228.
16. Lutz, R. J., & Reilly, P. J. (1973). An exploration of the effects of perceived social and perfomance risk on consumer information acquisition. In S. Ward & P. Wright (Eds.), *Adv. Consum. Res.* (Vol. I, pp. 393-405). Urbana, Illinois: Association for Consuemr Research.
17. Mitchell, V. W., & Greatorex, M., 1993. Risk perception and reduction in the purchase of consumer services. Service Industries Journal. 13(4), 179-200.

18. Miyazaki, A. D., & Fernandez, A. N. A., 2001. Consumer perceptions of privacy and security risks for online shopping. Journal of Consumer Affairs. 35(1), 27-44.
19. Peter, J. P., & Tarpey Sr, L. X., 1975. Behavioral decision making: A comparison of three models. Adv. Consum. Res. 2(1), 119.
20. Pires, G., Stanton, J., & Eckford, A., 2004. Influences on the perceived risk of purchasing online. Journal of Consumer Behaviour. 4(2), 118-131.
21. Roselius, T., 1971. Consumer rankings of risk reduction methods. The Journal of Marketing. 35(1), 56-61.
22. Tan, S. J., 1999. Strategies for reducing consumers' risk aversion in internet shopping. Journal of Consumer Marketing. 16(2), 163 - 180.
23. Van Den Poel, D., & Leunis, J., 1999. Consumer acceptance of the internet as a channel of distribution. Journal of Business Research. 45(3), 249-256.
24. Yuan, S.-T., & Lin, Y.-H., 2004. Credit based group negotiation for aggregate sell/buy in e-markets. Electronic Commerce Research and Applications. 3(1), 74-94.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

AN ANALYSIS OF PRICING TELECOMMUNICATIONS NETWORK SERVICES WITH DATA MINING METHODS

Jongsawas Chongwatpol†, NIDA Business School, National Institute of Development Administration, Thailand
email: jongsawas.c@ics.nida.ac.th

ABSTRACT

Research on developing pricing mechanisms for telecommunications service providers has been going on for decades. Many agencies have adopted various pricing schemes to charge their subscribers. However, due to the changes in the economic environment and technological infrastructure, the loss of subscribers is one of the important issues nowadays and these agencies need to adjust their pricing mechanisms to improve retention, to recover the cost of operations, and to maximize profitability. Practically, current pricing mechanisms do not reflect the changes in subscriber behaviors. This study seeks to fill this gap and examines how data mining techniques can help in making telecommunications pricing decisions. Consequently, any telecommunications service providers can evaluate their pricing strategy with respect to the organizational objectives and subscriber satisfaction perspectives.

An in-depth study of a state telecommunications service agency, OneNet - a division of the Oklahoma State Regents for Higher Education, is conducted. OneNet operates as an enterprise-type fund that provide cost-effective, equalized access to advanced network and telecommunications services to educational, governmental, and health care entities. OneNet must recover their costs through billing their subscribers and by justifying appropriations directly from the state legislatures.

Our experiments are based on a data base of 5,000 U.S. domestic subscribers. Many data mining techniques such as stepwise regression model, decision tree, and artificial neural network (ANN) are used to analyze data sets with multiple predictor variables, which include both network and non-network related factors. Our preliminary results show that types of circuits, membership fees, maintenance and repair costs of network-related equipment, and hub locations are the key factors that categorize OneNet's subscribers into four groups. Pricing mechanisms for each group are developed separately based on the identified key factor characteristics. Although we present this research in the context of OneNet, it is equally applicable to other providers of telecommunications services.

Key Words: Data Mining, Pricing, Telecommunications, Neural Network, Decision tree

INTRODUCTION

Research on developing pricing mechanisms for telecommunications service providers has been going on for decades. Many agencies have adopted various pricing schemes to charge their subscribers. However, due to the changes in the economic environment and technological infrastructure, the loss of subscribers is one of the important issues nowadays and these agencies need to adjust their pricing mechanisms to improve retention, to recover the cost of operations, and to maximize profitability.

Practically, current pricing mechanisms do not reflect the changes in subscriber behaviors. This study seeks to fill this gap and examines how data mining techniques can help in making telecommunications pricing decisions. Consequently, any telecommunications service providers can evaluate their pricing strategy with respect to the organizational objectives and subscriber satisfaction perspectives.

An in-depth study of a state telecommunications service agency, OneNet - a division of the Oklahoma State Regents for Higher Education, is conducted. We follow the CRISP-DM model, which is Cross Industry Standard Process for Data Mining. CRISP-DM model is used as a comprehensive data mining methodology and process model for conducting this data mining study by breaking down this data mining project in to six phases: business understanding, data understanding, data preparation, modeling, evaluation, and development. This study is organized as follows. First, related research on pricing telecommunications networks are briefly reviewed in Section 2. In section 3, we take a case study of OneNet, which is considering integrating Data Mining approach to help making pricing decisions. Our research methodology is then discussed in Section 4. Overall results of various predictive modeling and their discussions are presented in Section 5. Conclusion and future research direction are presented in the last section of this paper.

BRIEF LITERATURE REVIEW

Many pricing schemes have been proposed for pricing telecommunications networks. These pricing schemes can be classified into three main categories: cost-based pricing, pricing for best effort services, and pricing with Quality of Service (QoS) guarantees.

Cost-based pricing refers to prices that are directly related to costs. Some of the cost-based pricing models that have been proposed include Fully Distributed Cost (FDC) pricing, Ramsey pricing, and Flat rate pricing. FDC pricing is wildly used as it allocates the total common and shared costs that agency incurs while providing the services to the clients (Courcoubetis and Weber, 2003). Ramsey pricing is a linear pricing scheme that can be used to maximize social welfare and minimize economic misallocation under the constraint of recovering costs. Ramsey prices are sustainable when service providers charge different prices to different customer groups (Berg, 1998). Flat rate pricing is another well-known pricing structure used by service providers. A customer pays a fixed amount for a service at the time the contract is purchased regardless of the actual usage. Customers are charged the average cost of other customers in the same customer group (Courcoubetis and Weber, 2003).

"Best effort" refers to a network service that treats all types of traffic indifferently with no delivery guarantee and with the possibility of traffic loss (Shin et al., 2006). Best effort pricing scheme is employed to overcome the issues of fairness to customers and resource utilization in the case of cost-based pricing when some customers tend to overuse the resources and consequently is resulted in penalizing light users as compared to the heavy one. Usage-based pricing (Li and Wang, 2005, MacKie-Mason and Varian, 1995) is one of the first best-effort pricing schemes introduced to charge the customers for what they actually consume. This pricing scheme can be used to allocate service classes to different uses, to prioritize usage of a congested resource so that customers who value the access the most will get the highest priority, and to recover the costs of providing services. Congestion discount (Keon and Anandalingam, 2005) refers to a pricing approach using price discounts as an incentive to shift demand from congested to uncongested periods in telecommunications systems. Charging flexible contracts (Courcoubetis and Weber, 2003) can benefit both service providers and customers. Customers can vary the amount of bandwidth by changing their contract without the need to predict and reserve maximum resource requirements, while the service providers can provide more services to customers, with or without the need to reserve the resources.

Lastly, Quality of Service (QoS) refers to networks that are capable of providing better service to selected network traffic over various technologies by providing different priorities to different users or data flows, ensuring no traffic loss, and providing timely delivery guarantees (Shin et al., 2006, Guerrero-Ibanez et al., 2010, Keon and Anandalingam, 2005). QoS pricing involves technological enhancements such as Integrated Service (IntServ), Resource Reservation Protocol (RSVP), Multi-Protocol Label Switching (MPLS), and Differentiated Service (DiffServ) architectures (Shin et al., 2006). Thus, QoS pricing schemes introduced in the literature are related to these network architecture issues. For instance, Karsten et al. (1998) have proposed an embedded charging model in the RSVP architecture for an integrated services network. Fankhauser et al. (1998) included the RSVP charging and accounting in the IntServ network. Additionally, Bouras and Sevasti (2005) presented a model for the service provisioning procedure for the deployment of DiffServ-based Service Level Agreements (SLAs) in a bilateral fashion.

This brief literature review of network services pricing schemes is not intended to be comprehensive, but it does illustrate the large number of choices available to internet service providers to select and implement pricing models. However, these pricing schemes do not reflect the changes in customer behaviors, switching from one pricing mechanism to another. Additionally, there are many potentially important factors in both related to network and non-network variables that are neglected in the pricing decision. This study offers a wide range of decision variables based on the pricing evaluation though data mining approach. Consequently, such variables can be included in the current pricing schemes.

Case Example

OneNet, a division of the Oklahoma State Regents for Higher Education, operates as an enterprise-type fund that provide cost-effective, equalized access to advanced network and telecommunications services to educational, governmental, and health care entities. OneNet must recover their costs through billing their subscribers and by justifying appropriations directly from the state legislatures. The main clients served by OneNet are K-12 schools, colleges and universities, career technology centers, courts, libraries, state and federal agencies, and hospitals and clinics. OneNet established a cost-based pricing rate structure by focusing on the allocation of the costs of serving different types of clients and of different bandwidth offerings. Table 1 Presents OneNet's current rate charged to its clients with various bandwidth-based tier charges.

Table 1: Current Rate

No	Name	Mbps	Rate
1	SUD	0	$22.00
2	56K	0.056	$263.00
3	T1	1.5	$514.00
4	T1-OH	1.5	$514.00
5	Ethernet	10	$1,300.00
6	DS3	44.736	$3,510.00
7	Fast Ethernet	100	$2,300.00
8	OC-3	155	*ICB
9	OC-12	622	*ICB
10	Gigabit Ethernet	1000	*ICB

*ICB: Individual Case Basis

The rates OneNet currently charges for its services are quite straightforward, following a simple cost-based pricing model that averages all cost components for all clients at a given bandwidth rate. However, rapid changes in the economic environment, client utilization, and technologies have increased pressures on the network's infrastructure, client connection policies, and the operating budget, raising the question as to whether the current rates are adequate to recover its cost of operation. Another problem is that that current rate does not reflex the changes in i) financial support such as State Appropriations, State Universal Service, and private funding, ii) the operating budgets, or iii)network infra-structure. For instance, if funding support is cut, the revenue generated from these fixed rates will not cover OneNet's cost of operations. In addition, the current rate structure does not reflect the changes in E-Rate, funds from the Universal Service Fund to assist K-12 schools in obtaining affordable telecommunications and internet access. Additionally, other factors such as the high costs of new technology investments and upgrades, the costs to provide additional value-added services, or the cost associated with new bandwidth offerings generate the need to reassess whether OneNet's rates recover its costs of operations.

METHODOLOGY

In this study, we follow the CRISP-DM Model, a popular data mining method as a complete blueprint for this study (Shearer, 2000). After understanding the domain of pricing telecommunication network services and developing the objectives of achieving pricing decision though data mining approach, we begin our analysis by understanding the relevant data source, accessing data quality, and discovering first insights into the data. The next step is toward data preprocessing from the initial raw data to the final dataset, ready for the model development. This preprocessing step takes about 90% of time to clean, transform, construct, and format the relevant data. We then apply analytical data mining techniques to understand and predict rates charged to OneNet's clients. We also need to evaluate and assess the validity and the utility of our developed predictive models before deploying the data mining results into the domain as stated in the objectives of the study. Figure 1 presents the overall CRISP-DM framework of this study.

The first part of this study is to utilize data mining approach to understand the important factors that customers switch from OneNet to other internet service providers. The second part of this study focuses on determining the suitable pricing model for each customer group based on the customer segmentation profile.

Our experiments are based on a data base of 5,000 U.S. domestic subscribers in which 3,708 customers currently subscribed to OneNet's network and 1,292 customers are considered the loss of subscribers. A completed list of variables obtained, which include network and non-related network variables, is given. These variables, for instance, include

- Site ID, type of the organization, circuit speed, business location, equipment type, governing funding support, private funding support, circuit cost, equipment cost, administrative cost, rent expense, equipment maintenance expense, information service, library database subscriptions, membership fees, fiber relocation cost, and intra-agency payment.

Data Preparation

The next step in this analysis is to examine the quality of the data. In order to identify whether any inconsistencies, errors, or extreme values exist in the dataset, frequency distribution, descriptive statistics, and cross-tab analysis are performed. We then assess whether or not the data is complete or has missing values and what variables to be included in the model. Since including such variables with high-missing values in the model or even applying missing value imputation method can lower the quality of our findings, we make an assumption that the model excludes variables with over 50% information missing; see similar methodology from Park and Edington (2001).

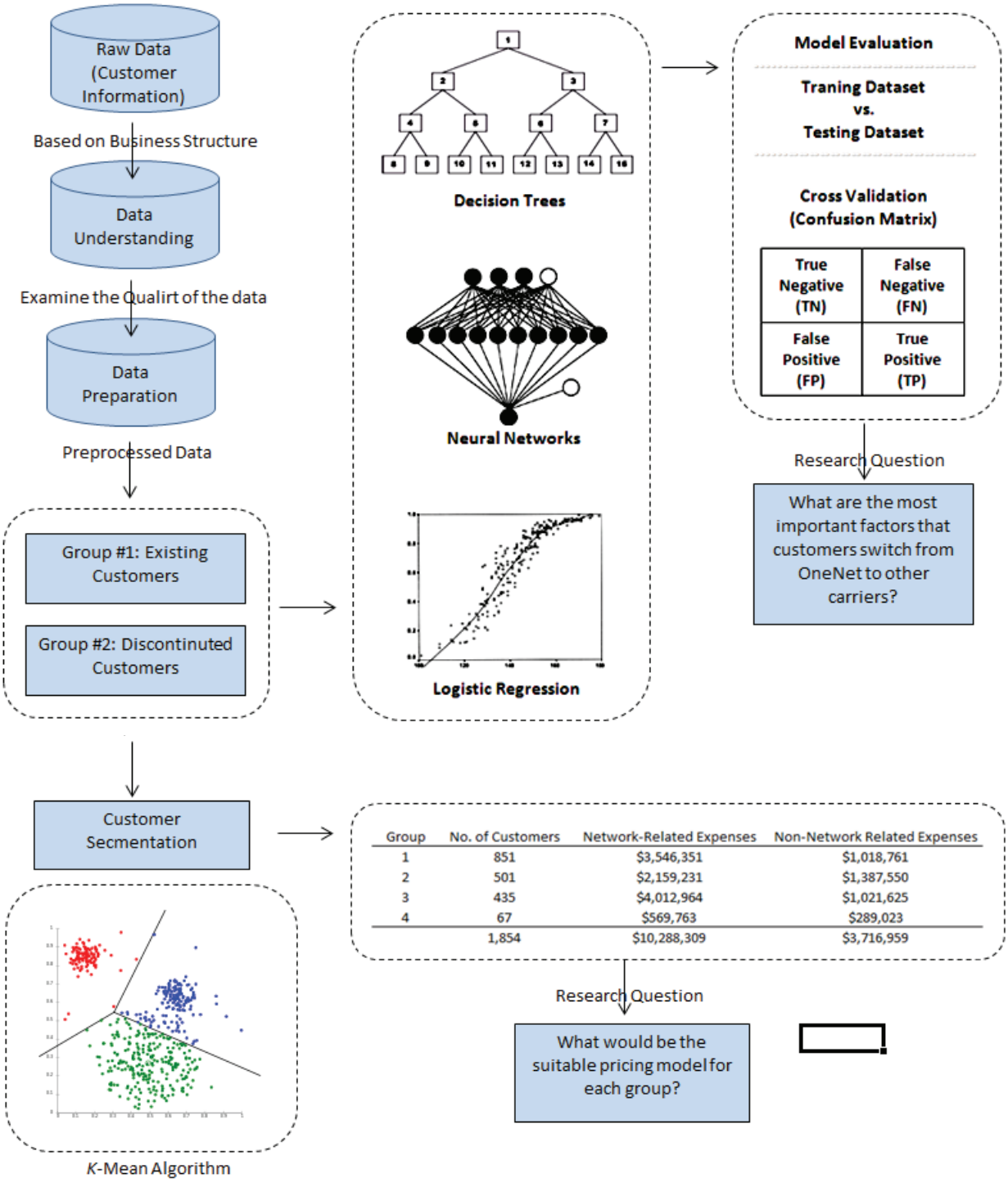


Figure 1: The Overall CRISP-DM Framework

Prediction Model

Many data mining techniques such as logistic regression model, decision tree, and artificial neural network (ANN) are used to analyze data sets with multiple predictor variables, which include both network and non-network related factors.

- Logistic regression is often used to predict an outcome variable that is binary or multi-class dependent variables. It allows the prediction of discrete variables (dependent variables) by a mix of continuous and discrete predictors as the relationship between dependent variables and independent variables is non-linear. It builds the model to predict the odds of its occurrence instead of point estimate event in the traditional linear regression model.
- Decision tree is another data classification and prediction method commonly used due to its intuitive explainability characteristics. Decision tree divides the dataset into multiple groups by evaluating individual data record, which can be described by its attributes. It is also simple and easy to visualize the process of classification where the predicates return discrete values and can be explained by a series of nested if-then-else statements.
- Artificial Neural Network (ANN) is a mathematical and computational model for pattern recognition and data classification through a learning process. It is a biologically inspired analytical technique, simulating biological systems, where learning algorithm indicates how learning takes place and involves adjustments to the synaptic connections between neurons. Data input can be discrete or real valued; meanwhile the output is in a form of vector of values and can be discrete or real valued as well.

For a technical summary including both algorithm and its applications see Jackson, 2002, Turban et al., 2011, and Shearer, 2000)

PRELIMINARY RESULTS

After excluding variables with outliers and high missing values, we first develop predictive models on the original sample dataset, which is composed of 2,400 records (1,200 existing customers and 1,200 losses of subscribers). The binary variable of OneNet's clients (Target = 1 for the loss of subscribers and Outcome = 0 for existing customers) is the output variable of the prediction models. After recoding all categorical input variables, the selected variables are tested whether the association between the input variables and the logit of binary target variable satisfy the linearity assumption. The problematic variables are then transformed to satisfy such assumption. Different models are constructed and compared in order to predict the loss of subscribers. Both training and testing datasets do not differ significantly for any of the variables studied. Training dataset is only used to extract models by the data mining algorithms. Then, those models derived in the training data set are then applied on the testing dataset for the correct discovery of intrusions. In other words, this testing dataset is used to prune the models generated by the data mining process in the training dataset to avoid overfitting and instabilities in the classification accuracy. Statistical analyses are performed using SAS Enterprise Guide 4.3 for data preparation and SAS Enterprise Miner 7.1 for model development and comparison.

We use three different criteria to select the best model on the testing dataset. These criteria include false negative, prediction accuracy, and misclassification rate. False negative (Target = 1 and Outcome = 0) represents the case of an error in the model prediction where model results indicate that hip fracture occurrence is not present, when in reality, there is an incident. The false negative value should be as low as possible. The proportion of cases misclassified is very common in the predictive modeling. However, the observed misclassification rate should be also relatively low for model justification. Lastly, prediction accuracy is evaluated among the three models on the testing dataset. The higher the prediction accuracy rate, the better the model to be selected. The details of performance measures are outlined as follows:

- True Negative (TN): the number of subscribers who are predicted to stay with OneNet and actually are staying with OneNet.
- True Positive (TP): the number of subscribers who are predicted to leave OneNet and actually were moved to other service providers.
- False Negative (FN): the number of subscribers who are predicted to stay with OneNet but actually were moved to other service providers.
- False Positive (FP): the number of subscribers who are predicted to leave OneNet but actually are staying with OneNet.

Figure 2 presents the classification table and the prediction results of the logistic regression, neural networks, and decision trees model. Neural network model produces the best results with overall misclassification rate of 8.69%, followed by the decision trees and logistic regression with misclassification rates of 9.29% and 9.46%, respectively. Neural Network model also has the lowest false negative rate of 8.59% and decision tree model comes out as the runner up with false negative rate of 9.19%. Thus, we select the neural network model as our final model to predict the loss of subscribers.

Our preliminary results show that types of circuits, circuit costs, government funding support, and hub locations are the key factors that lead to the loss of subscriber to OneNet.

		Target (Actual Value)	
		No (0)	**Yes (1)**
Outcome (Model)	**No (0)**	True Negative (TN)	False Negative (FN)
	Yes (1)	False Positive (FP)	True Positive (TP)
	Per-class Accuracy	TN/(TN+FP)	TP/(FN+TP)

Overall accuracy = (TP+T
False Negative = FN/(T
Misclassification Rate = (FP+F

Classificati

Outcome (Model)	Existing C		
	Loss of Subscribers (1)	79	763
	Total	840	840
	Per-class Accuracy	90.60%	90.83%
	Overall Accuracy	90.71%	
	False Negative	9.19%	
	Misclassification Rate	9.29%	

Classification Table (Logistic Regression)

Outcome (Model)		Target (Actual Value) (0)	(1)
	Existing Customers (0)	759	78
	Loss of Subscribers (1)	81	762
	Total	840	840
	Per-class Accuracy	90.36%	90.71%
	Overall Accuracy	90.54%	
	False Negative	9.32%	
	Misclassification Rate	9.46%	

Classification Table (Neural Networks)

Outcome (Model)		Target (Actual Value) (0)	(1)
	Existing Customers (0)	766	72
	Loss of Subscribers (1)	74	768
	Total	840	840
	Per-class Accuracy	91.19%	91.43%
	Overall Accuracy	91.31%	
	False Negative	8.59%	
	Misclassification Rate	8.69%	

Figure 2: Prediction Results and Model Comparison on the Testing Dataset

After understanding the causes of loss of subscribers, the next step is to determine the pricing mechanism so that OneNet can use in charging its clients appropriately. We first segment all 3,708 customers into sub-groups that share similar characteristics. The *k*-Means Algorithm is deployed in the clustering process. See Collica 2011, for the details on customer segmentation and clustering using SAS enterprise miner. Table 2 presents the group segmentation after applying the *k*-Means algorithm. Our preliminary results show that types of circuits, membership

fees, maintenance and repair costs of network-related equipment, and hub locations are the key factors that categorize OneNet's subscribers into four groups.

Table 2: Group Segmentation Based on the k-Means Algorithm

Group	No. of Customers	Network-Related Expenses	Non-Network Related Expenses
1	851	$3,546,351	$1,018,761
2	501	$2,159,231	$1,387,550
3	435	$4,012,964	$1,021,625
4	67	$569,763	$289,023
	1,854	$10,288,309	$3,716,959

Linear regression-based pricing is developed for each group. As a non-profit organization, the primary goal is cost recovery; therefore, the values of dependent variables for calibrating models are from the actual cost allocated to individual clients, defined as Rate (R_i) where "*i*" refers to the group members. In this analysis, we split the data at random into two sets (estimation and validation data), build the regression model on the estimation data, apply this regression model on the validation data, and then compare predictive fit and regression estimates between the estimation sample data and validation sample data. We also perform stepwise regression on these independent variables to simplify the model and to determine which variables are among the highest correlation with the dependent variables.

The following equation represented an example of the rate charged to its clients in group #1, where B_i refers to the baseline bandwidth subscription, L_i refers to the Last Mile Costs, and C_i refers to the channelized cost.

$$R_1 = 804.06 + 1.8\ (B_i) - 1.08609(L_i) + 1.853\ (C_i) \quad \text{--------- (1)}$$

The associated independent variables are varied among groups. However, a non-linear regression rate structure can also be appropriated to determine the rates charged to individual customers. For instance, Equation #2 represents the rate charged to member group #2.

$$R_2 = -35.90 + 875\ (B_i^{0.56}) \quad \text{--------- (2)}$$

The rate derived from the non-linear regression is based on the direct variation in bandwidth subscriptions. The higher the bandwidth clients subscribe to, the higher the rate charged to clients. In contrast, the rates derived from the linear regression vary not only depending mainly on the Last Mile, but also on the direct variation of bandwidth subscription and the reverse variation of the client group.

DISCUSSION AND CONCLUSION

With data mining approach, OneNet is able to understand the nature of its customers who switch to other carriers as they can provide the same services with the same or even lower rates. First, the preliminary results show that types of circuits, circuit costs, government funding support, and hub locations are the key factors that lead to the loss of subscriber to OneNet. OneNet can utilize this information to determine what incentives can be adjusted and offered to its clients to improve retention and, meanwhile, recover its cost of operations. For instance, since government funding is one of the key reasons of the loss of subscriber, the current rate charged to its customers should reflect the changes in funding support such as E-Rate, funds from the Universal Service Fund to assist K-12 schools in obtaining affordable telecommunications and internet access.

Secondly, we segment the customers into 4 groups based on customers' characteristics such as types of circuits, membership fees, maintenance and repair costs of network-related equipment, and hub locations. We then develop pricing model that is suitable for each group members. Consequently, OneNet can decrease the perception of unfairness to individual customers who tend to overuse the resources compared to other members in different groups. Linear and non-linear regression models are example of rates charged to customers in groups #1 and 2, respectively.

Note that we present this study as a pilot study to determine whether appropriate data is available, to understand the exploration of data mining approaches, and to develop initial models to determine what factors influence the pricing decision. With only 3,708 data records from an organization, our findings are still limited and the model and the model appears not to be generalizable. Thus, the final paper will include predictive modeling results with larger sample sizes and different organizations so that the finding can be applicable to other providers of telecommunications services.

REFERENCE

1. Berg, S. V. (1998). Basics of rate design: Pricing principles and self-selecting two-part tariffs. Paper presented at the Austrailian Competition and Consumer Commission, Melbourne, Australia.
2. Bouras, C., & Sevasti, A. (2005). Service level agreements for DiffServ-based services' provisioning. Journal of Network and Computer Applications, 28(4), 285-302.
3. Collica, R (2011). Customer Segmentation and Clustering Using SAS Enterprise Miner, Second Edition. Cary, NC: SAS Institute Inc.
4. Courcoubetis, C., & Weber, R. (2003). Pricing Communication Networks: Economics,Technology and Modelling. Hoboken, NJ: John Wiley & Sons Inc.
5. Fankhauser, G., Stiller, B., Christoph, V., & Plattner, B. (1998). Reservation-based Charging in an Integrated Services Network. Paper presented at the 4th INFORMS Telecommunications Conference, Boca Raton, FL,

6. Guerrero-Ibanez, A., Contreras-Castillo, J., Barba, A., & Reyes, A. (2010). A QoS-based dynamic pricing approach for services provisioning in heterogeneous wireless access networks. Pervasive and Mobile Computing, 7(5), 569-583.
7. Jackson, J.(2002), Data mining: a conceptual overview. Communications of the Association for Information Systems, 8: p. 267-296.
8. Karsten, M., Schmitt, J., Wolf, L., & Steinmetz, R. An embedded charging approach for RSVP. In Quality of Service, 1998. (IWQoS 98) 1998 Sixth International Workshop on, 1998 (pp. 91-100)
9. Keon, N., & Anandalingam, G. (2005). A new pricing model for competitive telecommunications services using congestion discounts. INFORMS Journal on Computing, 17(2), 248.
10. Li, K. F., & Wang, J. (2005). A Multi-Objective Internet Pricing Model. NWeSP.
11. MacKie-Mason, J. K., & Varian, H. R. (1995). Some FAQs about usage-based pricing. Computer Networks and ISDN Systems, 28(1-2), 257-265.
12. Park, J. and D.W. Edington (2001), A sequential neural network model for diabetes prediction. Artificial Intelligence in Medicine, 23(3): p. 277-293.
13. Shearer, C. (2000), The CRISP-DM model: the new blueprint for data mining. Journal of Data Warehousing, 5(4): p. 13-22.
14. Shin, S., F. Cope, R. I., F. Cope, R., & Tucci, J., E. (2006). Internet Pricing: Best Effort versus Quality of Service. Academy of Information and Management Sciences Journal, 9(2), 1.
15. Turban, E., R. Sharda, and D. Delen (2011), Decision Support and Business Intelligence Systems, Pearson

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

NEWCONNECT IN COMPARISON WITH MULTILATERAL TRADING FACILITIES IN EUROPE. IRREGULARITIES IN THE FUNCTIONING OF THE POLISH MTF MARKET.

Roman Asyngier, Maria Curie-Sklodowska University, Lublin, Poland
roman.asyngier@gmail.com

ABSTRACT

Introduction: *It is hard to consider five years of the functioning of the NewConnect market explicitly successful. On the one hand, the market quotes an increase of quoted instruments which is unusual in other multilateral trading facilities. On the other hand, it does not result in quality improvement of this market. Low value of public offers, limited share liquidity and excessive number of penny stock companies discourage investors from investing in this market and inhibit its further development.*
Methodology and the purpose of research: *An analysis of statistical data showing development of the NewConnect market will be presented in the article as well as its position in comparison with other multilateral trading facilities in Europe. It will help to achieve the goal of the article that is defining activity areas of the NewConnect market which inhibit its development. On the basis of organizational and legal solutions used by selected European markets, some actions will be indicated which could be implied by an organizer of the NewConnect market in order to eliminate its functioning problems.*
Results: *MTFs are currently organized by regulated markets(it is defined by Directive 2004/39/WE of European Parliament and Council from 21 April 2004 on Markets in Financial Instruments - MiFID) in 15 European countries. Straight majority of markets function as MTF(Multilateral Trading Facilities) and only three as regulated markets(RM). An unquestionable leader of multilateral trading facilities in Europe is London's AIM. Over a thousand of quoted companies are reflected in 40% of capitalization of European markets and generated turnover of their shares is over 56%(data from the end of 2012).*

Established in 2007 NewConnect is an average size MTF market in Europe as regards capitalization and turnover. However, the Polish market stands out strongly as far as the number of quoted companies is concerned. With the number of 429 issuers at the end of 2012, NewConnect is a vice-leader of juxtaposition. In the years 2010–2012 nearly 350 companies debuted on NC, which was almost half of debuts in all MTFs in Europe.

However, the amount does not result in a proportional increase of issuer capitalization and investors' interest measured by volume of trade. As regards mean capitalization of quoted companies, NC outdistances only the Luxemburg market. Equally bad the NC market looks in comparison with competitors as regards a mean transaction value which was only 350 Euro in 2012. Average turnover per one company is also one of the lowest among European MTFs. One of reasons of this state of things is a very low value of offers within IPO. In the years 2007–2012 it was only 670 thousand Euro and was definitely the lowest from all significant MTFs in Europe.

A negative perception of the NC market by investors is worsened by an excessive number of penny stock companies which results in rate variability, especially in case of companies with

share market value below 10 grosz. At the end of 2012 as many as 221 companies had unit price of shares below 1 PLN, from which even in 53 cases a closing price was lower than 10 grosz.

A key problem of the market is a poor financial condition of issuers. Nearly half of quoted on NC companies recorded losses in I half-year of 2012. At the end of 2012 as many as 68 companies had the value of owners' equity below one million PLN whereas in 13 cases the value was negative. Only from September 2012 to January 2013 13 companies filed a bankruptcy petition.

***Conclusions:** Lower value of public offers, low capitalization of companies, limited liquidity of shares, excessive number of penny stock companies and poor financial condition of issuers are basic drawbacks in the functioning of the NewConnect market. The consequence is a little interest of investors and decreasing turnover. And the result are falling valuations of quoted companies. Within the last 5 years NC Index has been the weakest index among significant MTFs in Europe in a direct comparison as well as regarding relative strength towards regulated markets in a particular country. Reasons for that state of things should be seen in an inappropriate organization of the NewConnect market and too liberal regulations allowing issuers' shares to enter stock exchange turnover.*

A market organizer should think first of all about toughening regulations which allow issuers to enter stock exchange market. In order to do that and following the example of Alternext and Entry Standard markets, the Warsaw Stock Exchange ought to introduce a minimal value of capitalization, share capital or an offer within IPO of issuer. Additionally, the organizer should determine a minimal free float of shares(the best way is to follow the example of Alternext – in quota terms) introduced into market turnover which will probably reduce the problem of dramatically low liquidity of many instruments. A solution for the issue of penny stock companies could be introduction of minimal market price of shares like it is in the First North market.

INTRODUCTION

Stock markets worldwide undergo constant rapid changes. In the times of growing competition among the major second-hand trading markets, they are looking for the market niches that can be taken advantage of. The aim is to provide the investors with easier and cheaper access to the ratings of various assets. This supports the development of a multi-segmental structure for financial instruments trading.

One of the fastest growing segments of this complex structure of financial instruments trading are securities trading platforms, named according to the Directive of the European Parliament, as multilateral trading facielities – MTF (European Union, 2004). Their history in Europe dates back to 1995, when the London Stock Exchange decided to launch the AIM market. In 2007, the Warsaw Stock Exchange joined the group of stock exchanges that organize multilateral trading facielities.

Five years of the Polish NewConnect market and related operations, however, cannot be definitely described as a success. On the one hand the market has recorded the growth of listed instruments, that unparalleled to other multilateral trading facielities. On the other hand, it does not reflect in the improved quality of this market. Low value of public offerings,

limited marketability of stock as well as excessive number of cheap or small-ticket companies, discourage the investors from investing in this market and hinder further development of this market.

This paper presents an analysis of statistical data showing the development of the NewConnect market and its position in comparison with the other multilateral trading facielities in Europe. This is to serve the aim of the article, that is to define the areas of the NewConnect that hinder its development. On the basis of organizational and legal solutions in a number of European markets, appropriate actions, that could be implied by the organizer of the NewConnect market to eliminate the operational problems, will be recommended.

PROFILE OF NEW CONNECT MARKET

In August 2007, the Warsaw Stock Exchange in Warsaw launched the NewConnect market, the model of which followed other similar markets in the world. The Polish MTF was created for start-up companies of a high technological potential and development, seeking to raise capital from several hundred thousand to several millions of zlotys (Pastusiak, 2007).
The market and its operations are mainly governed by the Alternative Trading System Regulations developed by the organizer of the market, namely the Warsaw Stock Exchange. As a non-regulated stock market, the NC is not under the direct supervision of the Financial Supervision Authority. Therefore, the law and related regulations governing the regulated market are inapplicable.

This results in low formal requirements to be met by the issuers attempting to emit the shares to trade in the Polish MTF. The most important are as follows:

- development of adequate documented information (information memorandum),
- unlimited transferability of stock,
- going concern - a company cannot be under bankruptcy or winding-up proceedings,
- assistance of an Authorised Adviser and Market Operator (Market Maker).

On 15th of April this year, concurrently with the launch of a new UTP trading system, the Warsaw Stock Exchange introduced new requirements for a minimum nominal value of shares (10 groszy) and free float (15% of the stock must be held by at least 10 stockholders, none of whom owns more than 5 % of voting rights at the General Assembly and is not affiliated with the issuer).[1]

A special role in the organization of the NC market is vested with the so-called Authorised Adviser (AD). This function is performed by financial, legal and investment advisory companies and audit companies that are included in the list kept by the MTF organizer. AD's role is to support the Issuer in the IPO process, especially in the preparation and approval of the information memorandum and placement of the issue. The Issuer is obliged to co-operate with the AD over a minimum of three years after its debut.

The Companies intending to place their stock in the MTF market might conduct the emission of shares within a public offering or a private placement. The public offering, according to the Polish law and related regulations needs to be addressed to more than 100 investors, and it entails drawing up a prospectus, approved by the FSA. Private placement, addressed to fewer than 100 investors, is easier to perform and much cheaper. In this case, the issuer

develops just an information memorandum approved by the Authorised Adviser (the Financial Supervision Authority's approval is not required).

Companies listed on the NC are obliged to fulfil the information requirements. An issuer is required to provide all the required information, that might have a significant impact on the valuation of listed financial instruments, in a form of relevant reports. Additionally, it needs to submit periodic reports on a quarterly and annual basis. Quarterly reports issued in an abridged version must contain selected financial data.[2] The full annual reports are audited.

Development of the NewConnect market in terms of the number of IPOs and listed companies is impressive. The year 2011 when the number of companies almost doubled was particularly notable in this regard. Despite significant declines of the NCIndex, particularly in the years 2008, 2011 and 2012, the market capitalization increased every year.

Table 1: Statistical data concerning NewConnect market in 2007-2013

Year	2007	2008	2009	2010	2011	2012	I-III 2013
Number of listed companies	24	84	107	185	351	429	436
Number of IPOs	24	61	26	86	172	89	12
Number of entries	0	1	3	8	6	11	5
NCIndex rates of return (%)	44,17	-73,51	30,14	27,65	-34,39	-20,09	-1,68
Market capitalization (millions of PLN)	1 185	1 437	2 554	5 138	8 488	11 088	10 241
The value of session turnover (millions of PLN)	151,3	413,2	539,7	1 753,3	1 858,5	1 140,9	238,1
Number of transactions	59 674	247 576	323 729	877 947	1 082 130	773 343	206 596
Number of transactions per session	719	980	1 285	3 470	4 311	3 106	3 332
Average capitalization of companies (millions of PLN)	49,38	17,11	23,87	27,77	24,18	25,85	23,49
The average value of turnover attributable to one company (millions of PLN)	6,30	4,92	5,04	9,48	5,29	2,66	2,18*
Average value of transaction per session (millions of PLN)	2 535,44	1 668,98	1 667,14	1 997,05	1 717,45	1 475,28	1 152,49

*Data restated for comparability for the full calendar year
Source: Own calculations based on data available at www.newconnect.pl

The volume of the stock listed in the Polish MTF is less impressive. While the value of the session-based turnover continued to grow until 2011, the growth rate was disproportionate to the increasing market capitalization. Apart from the initial operational period of the NC, that was not a full year, significant market indicators, i.e. the average company capitalization, the average value of turnover per one company, and the average value of transactions peaked in 2010.

The data for 2012 that is indicative of a nearly 40 percent drop in the turnover and nearly 30 percent drop in the number of transactions as compared to 2011 are particularly disturbing. The downward trend of turnover was also maintained in the first three months of 2013. If in the following months of this year, the data will not change significantly, the average turnover

per one company, and the average value of transactions will reach the lowest values in the whole history of the NC's operations.

MULTILATERAL TRADING FACIELITIES IN EUROPE

History of the alternative trading system markets in Europe is inseparably connected with the creation of the UK Alternative Investment Market. AIM has been designed for small-sized and emerging companies, satisfying the requirements of the regulated LSE market (Doidge et al., 2007). It has been intended to provide a kind of counterweight to the rapidly growing American over the counter NASDAQ market.

AIM, establish by the London Stock Exchange, was not only the first market of such kind in Europe. It has been a model to follow by newly created MTF markets in Europe. Despite the sizable success achieved by the AIM, European stock exchanges have been slow to start this type of market. Other mainstream European MTF today were established as late as in 2005 and they were: Alternext, Dritter Markt, First North, and the ESM (Table 1). One year later, the MAB Expension was established, and in 2007 this group was joined by Oslo Axess and NewConnect. Not all of the twenty-first century alternative markets in Europe still exist today. In 2008, the MTF markets were closed in Ljubljana and Bratislava.

The vast majority of markets operate as an MTF (*Eng. Multilateral Trading Facilities called)*, and only three of those are regulated markets *(RM – Eng. Regulated Market).* The Federation of European Securities Exchanges (FESE) in some countries, distinguishes several segments of the capital market, identifying them as special markets.[3] Such a situation has been the case in Italy. Besides the STAR market specified in the table, there still exist the Mercato Expandi (as the RM) and AIM Italia (as MTF).[4] Several European stock exchanges also operate alternative bonds trading.[5]

Table 2: Statistical data of multilateral trading facielities in Europe (at the end of 2012)

MTF Market / Stock exchange leading the MTF Market	RM/ MTF	Commencement Year	Number of companies	Market capitalization (in millions of €)	Volume size Number of transactions Turnover (in millions of €)		Average capitalization of company (in millions of €)	The average value of turnover per one company (in thousands of €)	Average value of transaction (in thousands of €)
Alternative Market (EN.A) Athens Exchange	MTF	Q4 2007	14	149,2	401	0,9	10,66	64,29	2,24
MAB Expansion BME (Spanish Exchanges)	MTF	I 2006	22	518,3	bd	bd	23,56	x	x
BETa CEESEG-Budapest	MTF	XI 2011	23	bd	9 125	22,9	x	995,65	2,51
STAR Borsa Italiana LSE Group	RM	IV 2001	66	13 277,0	2 180 723	5 550,7	201,17	84 101,52	2,55
Dritter Markt (MTF) CEESEG - Vienna	MTF	I 2002	22	1 003,2	7 759	17,8	45,60	809,09	2,29
Emerging Comp. Cyprus Cyprus Stock Exchange	MTF	IX 2004	15	609,5	bd	bd	40,63	x	x
Entry Standard Deutsche Börse	MTF	X 2005	183	9 562,6	312 444	709,3	52,25	3 875,96	2,27
ESM /Irish Stock Exchange	MTF	IV 2005	23	29 138,1	35 461	72,9	1 266,87	3 169,57	2,06
ISE Second National Market Istanbul Stock Exchange	RM	III 2003	77	3 991,5	15 413 448	11 812,8	51,84	153 412,99	0,77
AIM London Stock Exchange	MTF	VI 1995	1 096	50 085,2	5 445906	30 871,4	45,70	28 167,33	5,67

MTF Market / Stock exchange leading the MTF Market	RM/ MTF	Commencement Year	Number of companies	Market capitalization (in millions of €)	Volume size Number of transactions Turnover (in millions of €)		Average capitalization of company (in millions of €)	The average value of turnover per one company (in thousands of €)	Average value of transaction (in thousands of €)
Alternative Market (EN.A) Athens Exchange	MTF	Q4 2007	14	149,2	401	0,9	10,66	64,29	2,24
Euro MTF Luxembourg Stock Exchange	MTF	VI 2005	233	347,0	694	12,1	1,49	51,93	17,44
First North Alternative Market NASDAQ OMX	MTF	XII 2005	122	3 193,0	1 177 723	4 073,2	26,17	33 386,89	3,46
Alternext /NYSE Euronext	MTF	IV 2005	180	6 184,0	729 278	1 272,0	34,36	7 066,67	1,74
Oslo Axess /Oslo Børs	RM	V 2007	34	2 084,5	224 370	587,0	61,31	17 264,71	2,62
NewConnect Warsaw Stock Exchange	MTF	VIII 2007	429	2 723,7	773 343	273,5	6,35	637,53	0,35
Total/average			2 539	122 866,8	26 310 675	55 276,5	48,39	21 770,97	2,10

Source: Own calculations based on websites of stock exchanges and statistical data of the European Federation of Exchanges, the London Stock Exchange and Borsa Italiana:
http://www.fese.eu/en/?inc=art&id=4; http://www.londonstockexchange.com/statistics/markets/aim/aim.htm;
http://www.borsaitaliana.it/borsaitaliana/statistiche/sintesi-mensili/2012/sintesimensili201211.en_pdf.htm [14.03.2013]

AIM is now the undisputed leader of alternative systems in Europe in almost every way. More than a thousand of listed companies translates into 40% of the capitalization of European markets and generated stock sales volume representing more than 56% (Table 2). If we exclude the regulated markets (STAR, ISM and Oslo Axess) from the analysis, the advantage of British market over the rest of the European MTF would be overwhelming.

NewConnect is, in terms of capitalization and turnover, an average sized MTF market in Europe. Polish market definitely stands out in terms of the number of listed companies. With the number of 429 issuers at the end of 2012, NewConnect was the runner-up of the ranking. In 2010-2012 a number of 347 companies made their debuts in the NC, which accounted for almost half of new listings on all other MTF in Europe, and ranked the Warsaw Stock Exchange among the world leaders.[6]

Quantity, however, does not translate into a proportional increase in the capitalization of issuers and investors' growing interest measured by the volume of turnover. In terms of mid-cap listed companies, the NC is ahead of only the Luxembourg market. The NC market as compared to its competitors in terms of an average value of the transaction which in 2012 amounted only EUR 350 does not look promising either. Average turnover of a company is also one of the lowest among European MTF.

THE ORGANISATIONAL STRUCTURE OF SELECTED MARKET IN THE EUROPEAN MTF

In conformity with the Directive of the European Parliament, alternative markets may be established by the stock exchanges that lead the regulated markets (European Union, 2004). Stock exchanges organize MTF and set out the rules of their operation. The rule for the multilateral trading facielities is that formal requirements, fees and information obligations of issuers are much smaller than in the case of the major stock exchange markets (Mendoza, 2008; Gomber & Gsell 2006). This allows the companies that do not meet the requirements of the regulated market to raise capital from the capital market. It is of significant importance especially in fast-growing industries, based on intangible assets (modern technology), requiring different forms of funding sources.

Table 3: Comparison of the admittance requirements for stock issuers listed in the European MTF (as of 15 April, 2013)

	AIM	Alternext	Entry Standard	NewConnect	First North OMX	ESM
Minimum capitalization / equity capital	none	Min. capitalization 4,5 mln EUR	Min. equity capital EUR 750 thousand	none	none	Min capitalization 5 million EUR
Minimum age of the company	none	2 years	2 years	none	none	none
Minimum stock face value or issue price	none	None	Min. denomination of one share 1 EUR	Min. denomination of one share PLN 0,1	Min. price of issuance EUR 0,5	none
Min. free float	none	2,5 million EUR	10 % of issuance	15% of shares	10% of shares	none
The initial fee	depends on the capitalization of the company: min. 7396 – max. GBP 427971	depends on the capitalization of company: min. 10.000 – max. 3 million EUR	fixed EUR 1.500	fixed PLN 6.000	fixed EUR 5.400	fixed EUR 4.000
The annual fee for listing	depends on the capitalization of the company: min. 4863 – max. GBP 47926	depending on the number of shares min. EUR 2.800 – max. EUR 50.000	fixed EUR 5.000	1 year PLN 1.500, following – depending on the capitalization: min PLN 3.000 – max PLN 8.000	paid quarterly, depending on the capitalization of the company: min. EUR 1400 - max. EUR 9200	fixed EUR 4.000

	AIM	Alternext	Entry Standard	NewConnect	First North OMX	ESM
The obligation to cooperate with the adviser	Nominated Adviser – cooperation throughout the entire trading period	Listing Sponsor – cooperation throughout the entire trading period	Deutsche Börse Listing Partner - cooperation throughout the entire trading period	Authorized counsellor – cooperation throughout 3 years with the possibility of shortening to 1 year	Certified Adviser – cooperation throughout the entire trading period	Adviser – cooperation throughout the entire trading period

Source: Own calculations based on websites of MTF Dealership markets: https://europeanequities.nyx.com/listings/listing-fees; http://www.londonstockexchange.com/exchange/companies-and-advisors/main-market/listing-fees/aim-fees-calculator.html; http://www.boerse-frankfurt.de/de/wissen/marktsegmente/entry+standard; http://www.newconnect.pl; http://www.ise.ie/Equity-Issuers/MSM%20Vs%20ESM%20Rules/
[14.03.2013]

By setting out regulations for alternative markets, each stock exchange market is guided by the operational objectives. Despite generally related actions of respective MTF, the organizers are free to form any laws and related regulations which translate into a variety of adjustments. At this point, the operational principles of the six largest MTF in Europe organized as an MTF, in terms of capitalization and turnover, will be elaborated upon. The choice was made according to the ability to compare the organization of the most developed MTF affiliated to the NC market, which is aimed at achieving the assigned targets. Thus, the analysis excluded STAR, Oslo Axess and the ISE markets, organized as regulated markets. The criteria allowing for a fairly simple comparison were juxtaposed. The criteria defined in detail by the markets, like the information requirements of issuers were not covered by the analysis.

Table 3 contains the regulation-based requirements relevant to this article. The comparison clearly shows the London AIM as the most liberal one in terms of approach to the requirements to be met by the issuer in order to be admitted for listing in the stock exchange. There are no requirements relating to the minimum capitalization, distribution of stock, or the stock face value. The market is also available for start-ups.

Among the analyzed markets, the most stringent admittance rules apply to Alternext and Entry Standard, which have international ambitions (Hilton, 2008). These markets are not available to start-ups, as there is the admittance requirement to run business operations for at least two years before admittance is permitted. Both of them have also high requirements for capitalization or stock capital. To ensure adequate marketability of stock, both Alternext and Entry Standard fixed the minimum free float. Additionally, in the German market, the face value per share cannot be less than 1 EURO.

Very similar principles apply to First North and NewConnect. In both markets there is no capitalization-based requirements and the age of the company requirements. On the other hand, the criteria for stockholder dispersion and the value of one share apply but in the Scandinavian market there is the requirement for the minimum value of the shares, and in the Polish market – there is the requirement for the face value of the shares. It should be noted, however, that until March 2013, these criteria did not apply to the NewConnect market, and the market admittance requirements almost followed the ones applicable to the AIM market.

The Irish ESM market uses a very simple criterion for admittance, which is limited only to the size of the company's market capitalization. Out of all the analyzed markets, this criterion is the most demanding and is as high as 5 million Euros.

The organizational structure of all the analyzed MTF in Europe is based on the activity of the operators, that can, according to the Polish market, be described as Authorised Advisors. They perform primarily advisory services, provide support for the IPO process and fulfil the obligations posed for the companies listed on the stock exchange. In the respective markets their role may, however, be much more extensive. For example, in the London's AIM, the *Nominated Advisers* play also a supervising role for the stock exchange participants (Arcot et al., 2007). In all the analyzed markets, the issuer is obliged to co-operate with the Authorised Adviser, not only for the purpose of the IPO process but also during the entire period of trading. The Polish NC is the exception since the co-operation with the advisor is required for a period of only three years and can be shortened up to one year.

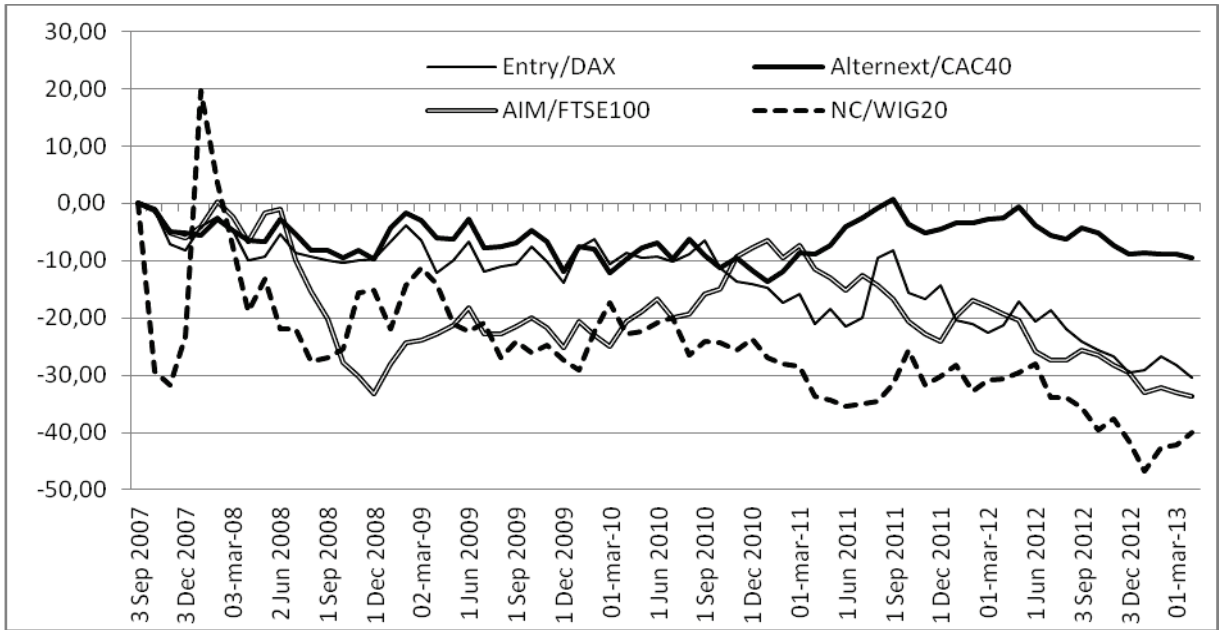
Each organizer of the MTF market makes the issuers liable for a fee payable for placement of financial instruments in the market and an annual fee for the listing of the shares. The approach of stock exchanges in the MTF markets is very different in this respect. A similar one is represented by AIM and Alternext markets, that charge high entry fee, the amount of which depends on the capitalization of the company.[7] As far as the Alternext fee is concerned, it seems outrageously high because it can reach up to 3 million Euros. This is due to the fact that the same rules apply to both the MTF and the main trading floor of the NYSE Euronext. However, taking into account the size of the capitalization of the companies seeking to enter the market share in those markets, usually not exceeding 100 million (EUR or GBP), the fee shall not exceed tens of thousands in the relevant currencies. On a similar basis both markets also charge an annual fee for the listing of the shares, whereas the maximum thresholds are clearly lower. The annual fee in the AIM depends again on the market capitalization of the company, and as far as the Alternext is concerned, on the number of shares placed in the market.

Admittance fees for all other markets are considerably lower and are payable at fixed rates. The fees payable do not differ much from one another and range from EUR 1,500 to EUR 5,400. In the case of fees payable for the trading of shares, Entry Standard and ESM markets consistently apply fixed rates. In the First North, as well as AIM, the fee is dependent on the capitalization and is calculated on a quarterly basis.

NewConnect uses a mixed system. In the first year of trading it charges a fixed rate fee in the amount of PLN 1500. In subsequent years, the fee is dependent on the height of the stock market capitalization and ranges from PLN 3000 up to PLN 8000.

AMENDMENT PROPOSALS IN THE CONTEXT OF THE NC MARKET PROBLEMS

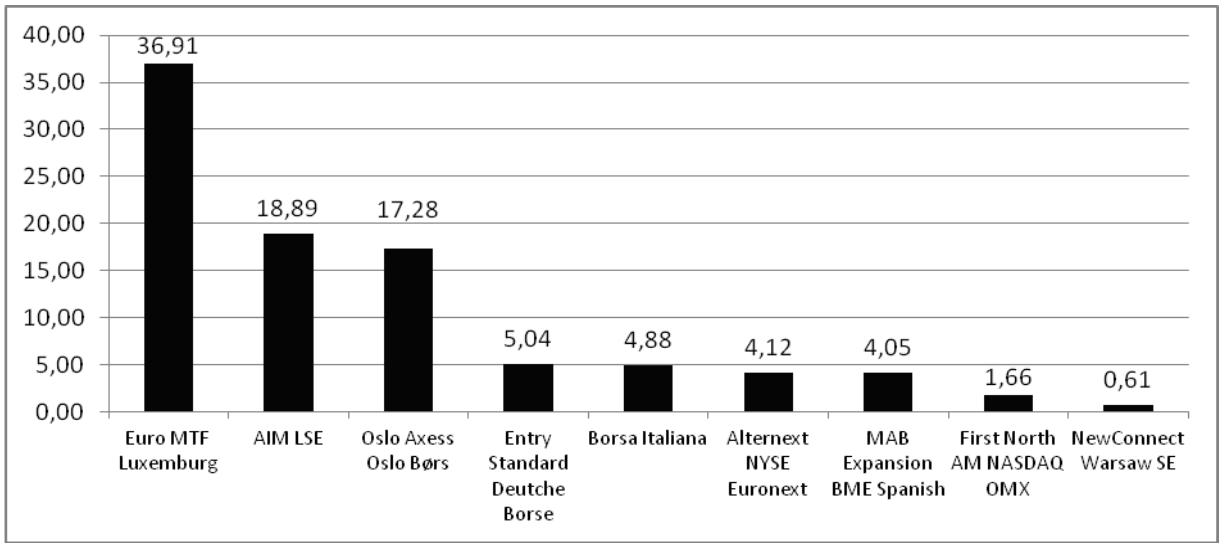
Low capitalization of companies and the limited stock marketability are the basic shortcomings of the NewConnect market, resulting from the comparison of the European MTF statistics. The consequence of that is the weakening interest of investors, disappearing sales and falling stock prices. The reluctance of investors to make transactions in the Polish market is clearly manifested by the relative strength of the selected alternative markets indices as compared to the regulated market indices, leading these markets (Figure 1). Since its inception, the relative strength of the NCIndex above decreased as compared to the WIG index by 40%. None of the MTF markets' indices presentedreported in this period was so weak in comparison to the domestic regulated market.



Source: Own study

Figure 1: Relative Strength Index of the MTF markets

It seems that this state of affairs result from too liberal rules governing the stock trading in the stock exchange and an organizational shortcomings in the primary market. There is no fixed or minimum capitalization requirements or the requirement for a target size of equity offerings in the NewConnect market. Furthermore, issuers use the simplest and least expensive path to the IPO by means of a private placement (private placement). Since the inception of the NC, only 17 issuers have decided to conduct public offerings.[8] It is suffice to say that in 2008-2012 the average value of the public offer equalled only to 613 thousands of EUR, which was by far the worst result of all the major European markets (Figure 1).



Source: Own study based on: http://www.pwc.pl/pl/ipo-watch-europe/index.jhtml [14.04.2013]

Figure 2: Average value of funds raised in the European MTF in 2008-2012 (in millions of EURO)

In this context, the organizer of the market should tighten the rules admitting issuers to the public market. First of all, according to the model of Alternext, Entry Standard and ESM, the Warsaw Stock Exchange should introduce the minimum value of capitalization, stock capital or public offer within the IPO issuer. This would eliminate the appearance of the "micro offers", that are a commonplace in the NC market.

In addition, the organizer should seek to reduce private placement or at least eliminate it (small free floMTF resulting in turnover limitations). Implementation of a minimum free float of 15% of shares traded in March 2013 is certainly a step in the right direction. However, concerning the average capitalization of a company listed in the NC, out of only 6.35 million Euros, 15% of the free float has an average value of less than 1 million Euros. It seems that following the model of the Alternext and the related introduction of the free float amount, for example, in the amount of at least 0.5-1.0 million Euro, would probably reduce the problem of dramatically low marketability of many instruments.

From the point of view of the aim of the article, an important issue of the NC market is the so-called "quality" of issuers admitted to trading, in terms of their financial and organizational background. The evidence of the problem is previously presented statistical data on mid-cap companies against the European MTF, as well as the financial results of the issuers. In 2012, less than 60% of them made a profit, and less than 10% of companies paid dividends. In this case, 19 companies had a negative book value and in nearly fifty companies it did not exceed 1 million PLN. At the end of the first quarter of 2013 as many as 28 companies have a market value of less than 1 million PLN.[9] The seriousness of the problem is indicated by the last verification of market segmentation made by the Board of the Warsaw Stock Exchange (26 March 2013). The segments of the NC High Liquidity Risk and NC Super High Liquidity Risk included 183 companies qualified by the organizer.[10] At the same time, in terms of the NC Lead index, created for the leaders of the market, who may apply for a transfer to a regulated market trading, only 18 companies were qualified.[11] However, a list of companies applying for bankruptcy is most disturbing. Only since September 2012 it has been reported that as many as 14 issuers filed for bankruptcy (liquidation or voluntary debt arrangements).

The reporting obligations, as well as compliance with the corporate governance rules for issuers are also challenging for the majority of issuers. The previous section of this article presented the solutions that can have a positive impact upon the operations of the Polish MTF, and it seems appropriate to introduce an obligation to co-operate with the Authorized Advisors throughout the entire trading of shares of the issuer, not just for the first year. Such regulations are applied by the MTF's and are further discussed in the article. It seems reasonable to impose a duty of prospects' monitoring on the AD's and increase the range of consultancy services for the issuer.

The negative perception of the NC market by investors is exacerbated by an excessive number of penny shares, resulting in high volatility in exchange, especially in the case of companies with a market capitalization of less than 10 groszy. At the end of the first quarter of 2013 more than half of the companies had a unit price of shares of less than 1 PLN, and in 56 cases the closing price was lower than of 10 groszy.[12]

Table 3: Market value of shares listed on the NewConnect market in 2007-2013

Price range	Number of shares at a given price range						
Year	2007	2008	2009	2010	2011	2012	III 2013
0,01-0,09	0	3	6	9	28	53	56
0,10-0,99	1	30	35	61	138	168	172
1,0-9,99	18	47	54	94	146	168	162
>10,00	5	4	12	21	39	40	49
Total number of companies	24	84	107	185	351	429	439
% of the company's share prices < 1 PLN	4,17	39,29	38,32	37,84	47,29	51,52	51,94
% of the company's share prices < 10 groszy	0,00	3,57	5,61	4,86	7,98	12,35	12,76

Source: Own study

The problem of cheap companies stems i.e. from the cost of carrying out the cheap stock issuance in a private placement and tolerance of deep splits by the organizer (complete or partial). Many a time the shares were sold at a price of a few dozen groszy, corresponding to the face value of the shares, and often the next big issues to be made at the lowest possible price of one grosz.

The introduction of the German model of Entry Standard and the Nordic First North of minimum face value of shares in the amount of PLN 0.1, will probably reduce the problem of new issuers only slightly, but will not affect the already listed companies. At the end of March 2013 three companies had a number of shares exceeding 1 billion of units, and another 29 - more than 100 million.[13]

The solution of the problem will probably require making a few adjustments at the same time. The organizer should raise the minimum market value of shares to the level of that applied by the Firt North (EUR 0.5). In addition, the proposed solution is to suspend the stock trading, when the arithmetic average market price during the last three months is less than 5 groszy, until the time of share consolidation process. In case of failure to comply with the prescribed re-split within a given time period, the shares of the issuer would be excluded from the stock market. In the case of the average rate of less than 10 groszy, it would be advisable to transfer them every time to a single-price auction. These rules not only restrain the problem of the "penny shares" but at the same time eliminate the problem of multi-million offers of shares sold at the lowest possible prices.

The issues to consider still include the fees for issuers and the minimum time of the issuer's operations (age). In the case of initial and annual fee for trading instruments, the related increase would rather not translate into an improvement of the issuers' "quality". In the context of the problems with excessive issues of shares, it is advisable to think about the establishment of the annual fee formulae, according to the Alternext model, that would be dependent on the number of shares placed in the market, and no longer on the NC-market capitalization. Regarding the minimum time of the companies' operations, applying for listing of the shares in the NC market should require for a minimum age of the issuer but it would be unjustified in the light of the NC market development strategy, because it was created with a view of, inter alia, emerging companies and stary-ups.

SUMMARY

After nearly five years of operations, the NewConnect market is at a crossroad. On the one hand, the market is developing dynamically, which comparing to other markets, is shown by an unprecedented growth of listed instruments. On the other hand, quantitative growth does not correlate with the improvement of the quality of the market and the interest of investors. Small capitalization of companies, and thus often low free float of shares, not a very good financial standing of the issuers and high volatility due to the excessive number of penny companies, effectively discourages investors from placing their funds in the market. This results in a very low increase in the turnover, inadequate to the rapidly increasing number of listed shares.

Trading regulations implemented by the Warsaw Stock Exchange in recent months should have a positive reception in the Polish MTF. In the author's opinion, these changes are too shallow and not sufficient to solve the problems accumulated over the years. Therefore, to restore the efficient operations of the NC, further changes are needed, which means sometimes bold and radical decisions of the market's Organizer.

The good news in terms of the introduction of the new regulations is the announcement of the forthcoming changes by the new President of Warsaw Stock Exchange, Mr. Adam Maciejewski. Representatives of the Warsaw Stock Exchange, the Association of Individual Investors and the Polish capital market entities continue the discussion on the need for further implementation of regulations that should be healing for the operations of the Polish MTF market.

Tags: NewConnect, Multilateral Trading Facilities, Capital Market, MiFiD, Regulation, Admission Fees.

REFERENCES

1. *AIM rules for Nominated Advisers*: http://www.londonstockexchange.com/companies-and-advisors/aim/publications/aim-rules-for-nominated-advisers.pdf
2. *Alternative Markets/Segments in equity analysis:* http://grahambishop.com/DocumentStore/d9cf5651-f676-4160-ab65-70b9e6ee6928.pdf
3. Arcot S., Black J., Owen G. (2007), *From local to global The rise of AIM as a stock market for growing companies, A comprehensive report analyzing the growth of AIM*, The London School of Economics and Political Science, s. 18–30.
4. Doidge C., Karolyi G.A., Stulz R.M. (2007), *Has New York become less competitive in global markets? Evaluating foreign listing choices over time*, European Corporate Governance Institute, Finance Working Paper No. 173/2007
5. European Union (2004), *Directive 2004/39/EC of the European Parliament and of the Council*. Markets in Financial Instruments Directive, released April 21st.
6. Gomber P., Gsell M. (2006), *Catching Up with Technology - The Impact of Regulatory Changes on ECNs/MTFs and the Trading Venue Landscape in Europe,* Competition and Regulation in Network Industries, Vol. 1, No. 4, pp. 535-557
7. Hilton A. (ed.) (2008), *AIM: The Growth Market of the Word*, Newsdesk Communications Ltd, London, s. 1-117

8. Mendoza J.M. (2008), *Securities regulation in low-tier listing venues: The rise of the Alternative Investment Market,* Fordham Journal of Corporate & Financial Law, Volume 13, Issue 2, p. 257-328
9. Pastusiak R. (2007), *Przedsiębiorstwo na rynku kapitałowym: operacje giełdowe rynku publicznego i niepublicznego*, CeDeWu, Warsaw

[1] http://www.newconnect.pl/pub/regulacje_prawne/Regulamin_ASO_UTP.pdf (legal status as of 15 April 2013).
[2] Specified in the Annex 3 to the MTF regulations:
http://www.newconnect.pl/pub/regulacje_prawne/Regulamin_ASO_UTP_zal_3.pdf
[3] *Alternative Markets/Segments in equity analysis:* http://grahambishop.com/DocumentStore/d9cf5651-f676-4160-ab65-70b9e6ee6928.pdf [13.04.2013]
[4] http://www.borsaitaliana.it/azioni/mercati/aim-italia/aim-italia.htm
[5] FESE statements mention eight of these markets, wherein the market in Bratislava is closed. Functioning markets are: Alternative Market (EN.A) Dritter Markt, Alternext, Emerging Bonds (Cyprus), GEM (Ireland), Oslo Alternative Bond Market (ABM) and Catalyst: http://www.fese.eu/en/?inc=art&id=4
[6] Details of IPOs on European markets can be found at: http://www.pwc.pl/pl/ipo-watch-europe/index.jhtml [14.04.2013]. Statistics for all stock exchange markets are published in the reports of the World Federation of Exchanges: www.world-exchanges.org/statistics/annual-statistics-reports [14.03.2013]
[7] Detailed description of the calculation of the initial payment is available in the documents:
http://www.londonstockexchange.com/companies-and-advisors/aim/for-companies/listing-fees/aim-brochure-2012-2013.pdf [30.12.2012]
https://europeanequities.nyx.com/sites/europeanequities.nyx.com/files/fee_book_2013_eng.pdf
[8] http://www.newconnect.pl/index.php?page=DebiutyNC [15.04.2013]
[9] Calculations based on data from the daily market session of 28 March 2013:
http://www.newconnect.pl/index.php?page=statystyki_dzienne [15.04.2013]
[10] In the segment of NC HLR were the shares of 149, and in the segment of NC SHLR - 34 issuers:
http://www.newconnect.pl/?page=informacje&ph_main_content_start=show&ph_main_content_cmn_id=9904 [14.04.2013]. Detailed rules for the NC market segmentation are described at:
http://www.newconnect.pl/index.php?page=segmenty_rynku_newconnect [12.04.2013]
[11]
http://www.newconnect.pl/?page=informacje&ph_main_content_start=show&ph_main_content_cmn_id=9905
[12] Own calculations based on data from the daily market session of 28 March 2013:
http://www.newconnect.pl/index.php?page=statystyki_dzienne [12.04.2013]
[13] Own calculations based on data from the daily market session of 28 March 2013:
http://www.newconnect.pl/index.php?page=statystyki_dzienne [12.04.2013]

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

CORRELATED RISK ASSESSMENT AND ITS MANAGERIAL APPLICATIONS

J. N. Pan, Department of Statistics, National Cheng-Kung University, Tainan, Taiwan (R.O.C.)
E-mail address: jnpan@mail.ncku.edu.tw

Sheau-Chiann Chen, National Chiayi University, Chiayi, Taiwan 60004, ROC.
E-mail address: scchen@mail.ncyu.edu.tw

ABSTRACT

In this paper, we present a new approach of correlated risk assessment by linking the multiple process capability indices and loss functions, in which the multivariate process capability indices and multivariate loss functions describe the likelihood and consequences as a result of nonconformities in multivariate manufacturing or environmental system respectively. Then, the associated relationship equations are developed using multivariate methods. Moreover, a step-by-step procedure is provided to facilitate the implementation of the correlated risk assessment.

Given the multivariate process capability indices, we show that the expected loss can be estimated by our developed relationship equations. Two numerical examples are also given to demonstrate how the correlated manufacturing and environmental risks can be properly assessed by linking the multivariate process capability indices and multivariate loss function. The risk information of likelihood and expected loss classified in the four planning zones of a strategic planning matrix provides practicing managers and engineers with a decision making tool for prioritizing their quality improvement projects when conducting risk assessment for any multivariate process or environmental system. Once the existing quality/environmental problems and their Key Performance Indicators (KPI) are identified, one may conduct risk assessment by applying the relationship equations to evaluate the impact of correlated risk on manufacturing processes or multiple environmental emissions inside company and it can lead to the direction of continuous improvement for any industry.

Keywords: Correlated risk assessment; multivariate process capability indices; multivariate loss functions; quality management; environmental management.

INTRODUCTION

In today's business environment, almost every industrial product has more than one quality characteristic and those characteristics may be correlated. Thus, it is important for companies to evaluate the correlated risks associated with their processes to increase the system safety and product quality. Environmentally speaking, this process of correlated risk analysis can also help reduce hazardous waste being released from their facilities. Traditionally, engineers perform process capability studies to analyze the key characteristic performance by using multivariate process capability indices for measuring process performance. Quality improvement actions can be taken if the process is not capable of meeting specifications. In addition, quality engineers seek to emphasize the urgency of process improvement to senior

management by quantifying the likelihood of nonconforming products and their impact on expected quality loss and costs (Pan and Lee, 2010).

Engineering System Risk Assessment (ESRA) systematically evaluates probabilities and consequences of acute, catastrophic failures ((Ayyub, 2003), (KarimiAzari et al., 2011), (Montague, 1990)). According to (Ayyub, 2003), risk is commonly evaluated as the product of the likelihood of occurrence and its impact or severity of its occurrence, namely, RISK= LIKELIHOOD x IMPACT, where likelihood is expressed as the probability of a nonconforming event and the impact represents risk as an expected value or as an average loss. Both (Montague, 1990) and (Ayyub, 2003) have discussed the Quantitative Risk Assessment (QRA) methods at length.

Recently, such quantitative risk assessment methods have been extended to supply chain management (Vilko and Hallikas, 2011) and the "green supply chain" (Wang et al., 2012), which is timely since environmental concerns are drawing much more attention from both academia and industry. Many Statistical Process Control (SPC) tools and principles as applied to quality management are equally useful in achieving environmental improvements. For instance, (Corbett and Van Wassenhove, 1995), and (Madu, 1996, 2004) offer a deep analysis of the broad range of quality control methods that can be applied to environmental management. One benefit of SPC is that it helps operators see and understand problems. Environmental SPC applications also have similar benefits. Operators rarely see the actual, negative impact of pollution caused by a process, but if it can be visualized in real-time through SPC much greater control is possible. (Corbett and Pan, 2002) propose that process capability indices, which measure the degree to which the process is capable of remaining below the existing regulatory limits, can be used as a measure of the environmental quality of a process.

Striking the right balance between tight controls of key processes and still maintaining cost-effectiveness is precisely the purpose of SPC. In order to prevent further environmental contamination, the adoption of SPC environmental risk assessment tools should include process capability indices and an associated loss function for accurately monitoring and evaluating environmental performance. A step towards correlating likelihood with expected loss was taken by (Pan, 2007) as a new loss function-based risk assessment method. It links univariate process capability indices (used to describe the likelihood of nonconforming events) and loss functions (used to describe the impact of such events). The likelihood and consequence resulting from the nonconformance is thus evaluated simultaneously.

The next step then is to build the linkage between the multivariate process capability indices and multivariate loss functions. Hence, this paper explores this relationship especially in terms of the correlated risk of a multivariate manufacturing process as well as assessing the correlated risk for an environmental system. Two numerical examples are given to demonstrate how the correlated manufacturing and environmental risks can be properly assessed by linking the multivariate process capability indices and multivariate loss function.

LITERATURE REVIEW

1. Risk assessment

A well-known classical method for conducting risk assessment is failure mode and effect analysis (FMEA), as described in for instance (Kolarik, 1995). Sometimes a criticality analysis component is added to this, as for instance in the D1-9000 standards at Boeing. This involves identifying each process step that may fail, then assigning rankings for occurrence probability, severity, and detectability. The "occurrence ranking" indicates how likely a failure is considered to be (where higher scores correspond to higher probabilities), and is related to the process capability indices. The "severity ranking" indicates the potential impact of a failure (with higher scores corresponding to more serious impact). The "detectability ranking" indicates how likely it is that a failure can go undetected until its full impact materializes; in the traditional quality control setting, this is the probability of shipping products containing an undetected defect. Higher scores again correspond to higher probability of defects going undetected. The three rankings are then multiplied, and higher total scores indicate higher risk. The other related applications of FMEA can be found in (Wang et al., 2009), (Kenchakkanavar and Joshi, 2010), (Chuang, 2010) and (Nassimbeni et al., 2012).

Risk assessment methods have also ranged from simple classical methods to fuzzy approach mathematical models. (Wang et al., 2009) proposed fuzzy risk priority numbers (FRPNs) for prioritization of failure modes. For solving the risk assessment model selection, (KarimiAzari et al., 2011) used the fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method to solve the risk assessment model selection problem under a fuzzy environment.

2. Multivariate process capability indices

In the past, univariate process capability indices have been used to measure the process performance. Various multivariate statistical methods are now employed when several quality characteristics are interdependent or correlated. (Wang and Chen, 1998) simplified the computation of multivariate process capability by using principal component analysis. (Chan et al., 1991) proposed a multivariate process capability index C_{pm} using the concept of Mahalanobis distance. (Chen, 1994) proposed a general multivariate capability index that allows elliptical and rectangular specifications. (Foster et al., 2005) later proposed a new multivariate capability index using a process-oriented basis representation.

To develop a quantitative capability measures of a multivariate process in relation to its specifications, (Taam et al., 1993) proposed two multivariate process indices MC_p and MC_{pm}. Their multivariate process capability index MC_{pm} is defined as the ratio of two volumes, i.e.

$$MC_{pm} = \frac{vol.(R_1)}{vol.(R_2)}, \qquad (1.)$$

where R_1 is a modified engineering tolerance region (see Figure 1) and R_2 is a scaled 99.73% process region, which is an elliptical region if the underlying process distribution is

assumed to be multivariate normal. Moreover, the modified engineering tolerance region is the largest ellipsoid that is centered at the target and falls within the original engineering tolerance region. Thus, the MC_{pm} index can be rewritten as

$$MC_{pm} = MC_p \frac{1}{D}, \qquad (2.)$$

where $D = (1 + (\boldsymbol{\mu} - \mathbf{T})'\boldsymbol{\Sigma}^{-1}(\boldsymbol{\mu} - \mathbf{T}))^{1/2}$ is a correcting factor if the process mean $\boldsymbol{\mu}$ deviates from the target $\mathbf{T}$, $\boldsymbol{\Sigma}$ is process covariance and MC_p is written in Equation (10)

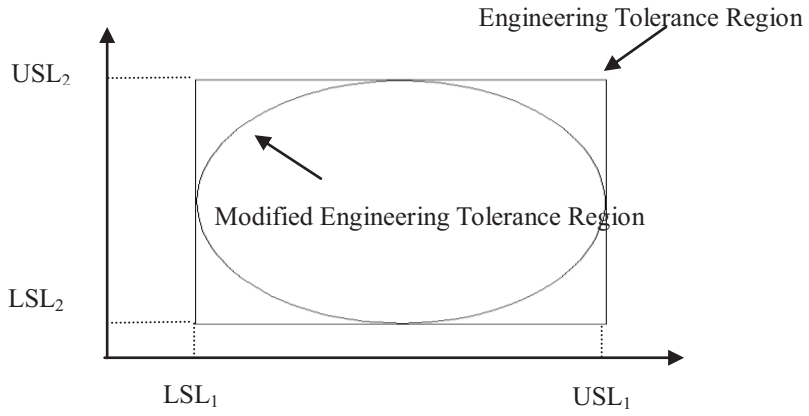


Figure1: Illustration of engineering tolerance region and modified engineering tolerance region.

(Wang and Du, 2000) proposed to use principal component analysis to evaluate the process performance for multivariate data. (Wang et al., 2000) reviewed the three multivariate process capability indices proposed by (Hubele et al., 1991), (Taam et al., 1993) and (Chen, 1994). They pointed out that Hubele's three-component capability vector lacks simplicity and could be confusing in its interpretation and use. Although Taam's MC_{pm} index accurately reflects process variability and centeredness, it does not take into account the correlation between multiple quality characteristics. (Pan and Lee, 2010) revised Taam's modified engineering tolerance region based on the assumption that the correlation of multiple quality characteristics is consistent with the correlation among specifications. The relationship between Taam's modified engineering tolerance region (the regular one) and our revised engineering tolerance region (the slant one) for a process with a bivariate quality characteristic is illustrated in Figure 2.

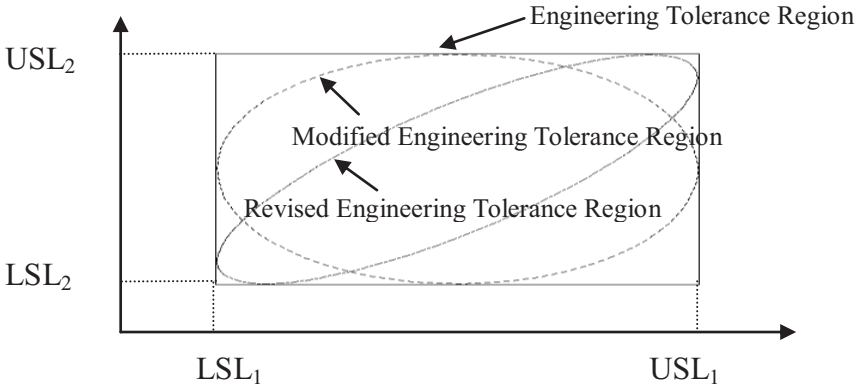


Figure 2. Relationship between Taam's modified region and Pan and Lee's revised engineering tolerance region

To overcome the drawback of overestimation using the MC_p and MC_{pm} indices, (Pan and Lee, 2010) proposed a revised engineering tolerance region (see Figure 2) and redefine new multivariate process capability indices, NMC_p and NMC_{pm} indices. Similar to MC_{pm} ratio of the two volumes shown in Equation (1), the new multivariate process capability index can be defined as

$$NMC_{pm} = \frac{Vol.(E_{d,\mathbf{A}^*,\mathbf{T}})}{Vol.(E_{d,\boldsymbol{\Sigma},\boldsymbol{\mu}})}\left(1+(\boldsymbol{\mu}-\mathbf{T})'\boldsymbol{\Sigma}^{-1}(\boldsymbol{\mu}-\mathbf{T})\right)^{-1/2}, \tag{3.}$$

where a revised engineering tolerance region

$$E_{d,\mathbf{A}^*,\mathbf{T}} = \left\{\mathbf{X}\in\mathbf{R}^v \mid (\mathbf{X}-\mathbf{T})'(\mathbf{A}^*)^{-1}(\mathbf{X}-\mathbf{T}) = d^2\right\}, \tag{4.}$$

and where the elements of matrix $\mathbf{A}^*$ are given by

$$\rho_{ij}\left(\frac{USL_i - LSL_i}{2d}\right)\left(\frac{USL_j - LSL_j}{2d}\right) \quad i,j = 1,\ldots,v, \tag{5.}$$

$\mathbf{T}$ is the target vector, ρ_{ij} represents the correlation coefficient between the *i*th and *j*th quality characteristics and $(USL_i - LSL_i)$ denotes the *i*th specification width for each side of rectangle circumscribed to the ellipsoid $E_{d,\mathbf{A}^*,\mathbf{T}}$. The NMC_p index can be used to evaluate the performance of process precision (i.e. the variability in relationship to the revised engineering tolerance region) and the NMC_{pm} index can be used to evaluate both process precision and accuracy (i.e. the deviation from the target).

3. Loss function for multivariate cases

(Pignatiello, 1993) presented a quadratic loss function for multiple-response quality problems. He showed that this function is a generalization of the single-response Taguchi's quadratic loss function. The multivariate loss function can be defined as

$$Q = (\mathbf{X} - \mathbf{T})'\mathbf{C}(\mathbf{X} - \mathbf{T}), \tag{6.}$$

where **X** is a *px1* vector of quality characteristics, **C** is a *pxp* positive definite matrix of costs which represent the losses incurred when **X** deviates from the target vector, **T** is the target vector for *p* quality characteristics of interest, p is the number of quality characteristics. The quality loss matrix **C** can be expressed as

$$\mathbf{C} = \begin{bmatrix} C_{11} & C_{12} & \cdots & C_{1p} \\ C_{21} & C_{22} & \cdots & C_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ C_{1p} & C_{2p} & \cdots & C_{pp} \end{bmatrix}. \tag{7.}$$

Note that if C is a diagonal matrix, then the loss function is the sum of *p* single-response quadratic loss functions. For non-diagonal **C** matrices, the off-diagonal elements are related to the incremental losses that are incurred when the *i* th and the *j* th pair of quality characteristics are simultaneously off-target.

(Pignatiello, 1993) further showed that the expected multivariate loss function can be expressed as:

$$E(Q) = (\boldsymbol{\mu} - \mathbf{T})'\mathbf{C}(\boldsymbol{\mu} - \mathbf{T}) + tr(\mathbf{C}\boldsymbol{\Sigma}). \tag{8.}$$

RELATIONSHIP BETWEEN $MC_{p,pm}$, $NMC_{p,pm}$ CAPABILITY INDICES AND EXPECTED LOSSES

1. Relationship between $MC_{p,pm}$ capability indices and expected loss function

Assuming that the vector **X** of quality characteristics follows a p-dimensional multivariate normal distribution with mean vector $\boldsymbol{\mu}$, variance-covariance matrix $\boldsymbol{\Sigma}$ and its Taam's process capability indices $MC_{p,pm}$ values are given, then the relationship between $MC_{p,pm}$ capability indices and expected loss function can be derived as below:

1.1 The nominal-the- best case

Given the MC_p, MC_{pm} values and $MC_{pm} = MC_p / D$, the relationship equation can be written as

$$\left(\frac{MC_p}{MC_{pm}}\right) = \left(1 + (\boldsymbol{\mu} - \mathbf{T})'\boldsymbol{\Sigma}^{-1}(\boldsymbol{\mu} - \mathbf{T})\right)^{1/2}, \tag{9.}$$

where the MC_p index represents the ratio of a modified tolerance region with respect to the process variability as written in Equation (10).

$$MC_p = \frac{\left(\prod_{i=q}^{v} r_i\right)\pi^{v/2}\left[\Gamma(v/2)+1\right]^{-1}}{|\boldsymbol{\Sigma}|^{1/2}\left(\pi K(v)\right)^{v/2}\left[\Gamma(v/2)+1\right]^{-1}}, \tag{10.}$$

where $r_i = (USL_i - LSL_i)/2$, $i = 1,...,v$, USL_i is the upper specification limit for the *i*th quality characteristic, LSL_i is the lower specification limit for the *i*th quality characteristic, $|\cdot|$ is a notation of determinant and $\Gamma(\cdot)$ is a Gamma function. Taking the square on Equation (9), one can obtain Equation (11)

$$\left(\frac{MC_p}{MC_{pm}}\right)^2 - 1 = (\boldsymbol{\mu} - \mathbf{T})'\boldsymbol{\Sigma}^{-1}(\boldsymbol{\mu} - \mathbf{T}). \tag{11.}$$

Equation (9) will vanish if $MC_p = MC_{pm}$, which means the process is on-target and the first term in Equation (8) becomes zero. Thus, we only need to consider the loss due to the process variation and the expected loss function can be reduced to $E(Q) = tr(\mathbf{C\Sigma})$。

Referred to the lemma stated in (Johnson and Wichern, 2007), the relationship between determinant and trace can be expressed as Equation (12).

$$tr(\mathbf{B}) = \sum_{i=1}^{p} \frac{|\mathbf{B}|}{|\boldsymbol{\Lambda}_{(i)}|}, \tag{12.}$$

where **B** is a *p* x *p* positive definite matrix, $|\boldsymbol{\Lambda}_{(i)}| = \prod_{k=1,k\neq i}^{p} \lambda_k$, λ_i is the *i* th eigenvalue of **B** matrix. By Equation (12), one can derive the relationship equation between expected quality loss and MC_p index.

$$E(Q) = tr(\mathbf{C\Sigma}) = \frac{1}{(MC_p)^2}\left(|\mathbf{C}||\mathbf{M}|\sum_{j=1}^{p}\frac{1}{|\boldsymbol{\Lambda}_{(j)}|}\right), \tag{13.}$$

where $|\boldsymbol{\Lambda}_{(j)}| = \prod_{k=1,k\neq j}^{p} \lambda_k$, λ_j is the *j* th eigenvalue of $\mathbf{C\Sigma}$ matrix, $\mathbf{M} = diag\left(r_i^2 / \chi^2_{p,0.9973}\right)$, $\chi^2_{p,0.9973}$ is the 99.73% percentile of Chi-square distribution with *p* degree of freedom.

For the nominal the better case, MC_p and MC_{pm} values will be different if the process mean deviates from the target. To derive the relationship equation between the total expected loss and $MC_{p,pm}$ indices, we consider both the quality loss due to the process variation which can be expressed by Equation (12) and the quality loss due to the process mean deviated from the target which can also been expressed by the $MC_{p,pm}$ values using the following lemma stated in (Johnson and Wichern, 2007).

$$\mathbf{x}'\mathbf{B}\mathbf{x} = \left(\frac{\sum_{i=1}^{p} \lambda_i y_i^2}{\sum_{i=1}^{p} y_i^2} \right) \mathbf{x}'\mathbf{x}, \tag{14.}$$

where $\mathbf{B}$ is a $p \times p$ positive definite matrix, $\mathbf{x} \neq \mathbf{0}$, λ_i is the i th eigenvalue of $\mathbf{B}$ matrix, $\mathbf{y} = \mathbf{P}'\mathbf{x}$, $\mathbf{P}$ is the orthogonal matrix consisting of p unit eigenvectors.

By Equations (13) and (14), one can derive the following relationship equation between expected loss and Taam's $MC_{p,pm}$ values

$$E(Q) = k_N \left(\left(\frac{MC_p}{MC_{pm}} \right)^2 - 1 \right) + \frac{1}{(MC_p)^2} \left(|\mathbf{C}||\mathbf{M}| \sum_{j=1}^{p} \frac{1}{|\mathbf{\Lambda}_{(j)}|} \right), \tag{15.}$$

where k_N is the ratio of " $(\boldsymbol{\mu} - \mathbf{T})'\mathbf{C}(\boldsymbol{\mu} - \mathbf{T})$ divided by $(\boldsymbol{\mu} - \mathbf{T})'\boldsymbol{\Sigma}^{-1}(\boldsymbol{\mu} - \mathbf{T})$ ", $|\mathbf{\Lambda}_{(j)}| = \prod_{k=1, k \neq j}^{p} \lambda_k$, λ_j is the j the eigenvalue of $\mathbf{C}\boldsymbol{\Sigma}$ matrix.

Equation (15) implies that given Taam's MC_p , MC_{pm} values and quality loss matrix **C,** the expected quality loss for nominal-the-best case can be estimated.

1.2. The smaller- the- better case

Assuming that the vector $\mathbf{X}$ of quality characteristics follows a p-dimensional multivariate normal distribution with mean vector $\boldsymbol{\mu}$, variance-covariance matrix $\boldsymbol{\Sigma}$, then the MC_{pm} index can be written as Equation (16) for the smaller the better case.

$$MC_{pm} = \frac{MC_p}{\left(1 + \boldsymbol{\mu}'\boldsymbol{\Sigma}^{-1}\boldsymbol{\mu}\right)^{1/2}}. \tag{16.}$$

By setting $\mathbf{T}$ =0 in Equation (11), one can obtain Equation (17).

$$\left(\frac{MC_p}{MC_{pm}} \right)^2 - 1 = \boldsymbol{\mu}'\boldsymbol{\Sigma}^{-1}\boldsymbol{\mu}. \tag{17.}$$

If the quadratic loss function is considered, then the expected loss can be expressed as Equation (18).

$$E(Q) = \boldsymbol{\mu}'\mathbf{C}\boldsymbol{\mu} + tr(\mathbf{C}\boldsymbol{\Sigma}). \tag{18.}$$

Given $MC_{p,pm}$ values, one can derive the following relationship equation between expected loss and $MC_{p,pm}$ values via Equation (19) for the smaller the better case.

$$E(Q) = k_S\left(\left(\frac{MC_p}{MC_{pm}}\right)^2 - 1\right) + \frac{1}{(MC_p)^2}\left(|\mathbf{C}||\mathbf{M}|\sum_{j=1}^{p}\frac{1}{|\boldsymbol{\Lambda}_{(j)}|}\right), \tag{19.}$$

Where k_S is the ratio of $\boldsymbol{\mu}'\mathbf{C}\boldsymbol{\mu}$ divided by $\boldsymbol{\mu}'\boldsymbol{\Sigma}^{-1}\boldsymbol{\mu}$, $|\boldsymbol{\Lambda}_{(j)}| = \prod_{k=1,k\neq j}^{p}\lambda_k$, λ_j is the j the eigenvalue of $\mathbf{C}\boldsymbol{\Sigma}$ matrix。

Equation (19) implies that given Taam's MC_p , MC_{pm} values and quality loss matrix **C,** the expected quality loss for smaller- the- better case can be estimated.

2. Relationship between $NMC_{p,pm}$ capability indices and expected loss function

Similar to the proof as stated in section 3.1, one can derive the following relationship equation between expected loss and $NMC_{p,pm}$ values hold for the nominal-the-better case:

$$E(Q) = k_N\left(\left(\frac{NMC_p}{NMC_{pm}}\right)^2 - 1\right) + \frac{1}{(NMC_p)^2}\left(|\mathbf{C}||\mathbf{A}^*|\sum_{j=1}^{p}\frac{1}{|\boldsymbol{\Lambda}_{(j)}|}\right), \tag{20.}$$

where k_N is the ratio of " $(\boldsymbol{\mu}-\mathbf{T})'\mathbf{C}(\boldsymbol{\mu}-\mathbf{T})$ divided by $(\boldsymbol{\mu}-\mathbf{T})'\boldsymbol{\Sigma}^{-1}(\boldsymbol{\mu}-\mathbf{T})$ ", $|\boldsymbol{\Lambda}_{(j)}| = \prod_{k=1,k\neq j}^{p}\lambda_k$, λ_j is the j the eigenvalue of $\mathbf{C}\boldsymbol{\Sigma}$ matrix. In Equation (4), if we let $d^2 = \chi^2_{1-\alpha,v}$, then the NMC_p index can be written as

$$NMC_p = \frac{|\mathbf{A}^*|^{1/2}\left(\pi\chi^2_{1-\alpha,v}\right)^{v/2}\left[\Gamma\left(\frac{v}{2}+1\right)\right]^{-1}}{|\boldsymbol{\Sigma}|^{1/2}\left(\pi\chi^2_{1-\alpha,v}\right)^{v/2}\left[\Gamma\left(\frac{v}{2}+1\right)\right]^{-1}} = \left(\frac{|\mathbf{A}^*|}{|\boldsymbol{\Sigma}|}\right)^{1/2} \tag{21.}$$

and the NMC_{pm} index can be written as

$$NMC_{pm} = NMC_p / D, \tag{22.}$$

where $D = (1 + (\boldsymbol{\mu} - \mathbf{T})'\boldsymbol{\Sigma}^{-1}(\boldsymbol{\mu} - \mathbf{T}))^{1/2}$. The term D in Equation (22) denotes a function of Mahalanobis distance between the process mean and target vector $\mathbf{T}$. It can be used to measure the process deviation from target vector $\mathbf{T}$. Note that the univariate C_p and C_{pm} indices can be considered as a special case of new multivariate NMC_p and NMC_{pm} indices if $v = 1$ and $1 - \alpha = 0.9973$.

Equation (20) implies that given Pan and Lee's NMC_p, NMC_{pm} values and quality loss matrix **C,** the expected quality loss for nominal-the-best case can be estimated.

If the quadratic loss function is considered, then the expected loss can be expressed as Equation (18). Given NMC_p and NMC_{pm} values, one can derive the following relationship equation between expected loss and $MC_{p,pm}$ values by Equation (23) for the smaller the better case.

$$E(Q) = k_S\left(\left(\frac{NMC_p}{NMC_{pm}}\right)^2 - 1\right) + \frac{1}{(NMC_p)^2}\left(|\mathbf{C}||\mathbf{A}^*|\sum_{j=1}^{p}\frac{1}{|\boldsymbol{\Lambda}_{(j)}|}\right), \qquad (23.)$$

Where k_S is the ratio of $\boldsymbol{\mu}'\mathbf{C}\boldsymbol{\mu}$ divided by $\boldsymbol{\mu}'\boldsymbol{\Sigma}^{-1}\boldsymbol{\mu}$, $|\boldsymbol{\Lambda}_{(j)}| = \prod_{k=1,k\neq j}^{p}\lambda_k$, λ_j is the j the eigenvalue of $\mathbf{C}\boldsymbol{\Sigma}$ matrix. Equation (23) implies that given Pan and Lee's NMC_p, NMC_{pm} values and quality loss matrix **C,** the expected quality loss for smaller-the-better case can be estimated.

To facilitate practitioners in conducting the correlated risk assessment, a step-by-step procedure is listed as below.

1. Perform a multivariate process capability study with the required sample size.
2. Collect measurement data and perform a normality test for the collected data.
3. Calculate the new NMC_p and NMC_{pm} indices using Equations(21) and (22).
4. Given the new NMC_p and NMC_{pm} indices, calculate the expected losses for either nominal-the-best or smaller-the-better cases using Equations (20) and (23) respectively.
5. Perform the sensitivity analysis of risk (obtain various expected losses under different hypothetical process capability indices) and then setup a realistic goal for future quality improvement.
6. Evaluate the risk information of likelihood (reflected by process capability indices) and expected losses (represent impact) for different multivariate processes. Then prioritize various quality improvement projects by using the strategic planning matrix as shown in Figure 5.

NUMMERICAL EXAMPLES

Example 1 Manufacturing risk assessment using Sultan's manufacturing data.

(Sultan, 1986) discussed an example in which the Brinell hardness (H) and tensile strength (S) are two quality characteristics for an industrial product. The engineering tolerances for H and S are given by (112.7, 241.3) and (32.7, 73.3) respectively and the target vector of H and S is $\mathbf{T}' = [177, \quad 53]$. After collecting 25 measurements as listed in Table 1, a multivariate process capability study is conducted (assuming the process is in control).

Table 1. The 25 measurements of Brinell hardness (H) and tensile strength (S) for an industrial product.

H	S	H	S	H	S
143	34.2	141	47.3	178	50.9
200	57.0	175	57.3	196	57.9
160	47.5	187	58.5	160	45.5
181	53.4	187	58.2	183	53.9
148	47.8	186	57.0	179	51.2
178	51.5	172	49.4	194	57.5
162	45.9	182	57.2	181	55.6
215	59.1	177	50.6		
161	48.4	204	55.1		

By performing Shapiro-Wilk test, we found that the 25 collected measurements follow a multivariate normal distribution with the sample mean vector $\bar{\mathbf{X}}' = [177.2, \quad 52.32]$ and the sample covariance matrix $\mathbf{S}$, where

$$\mathbf{S} = \begin{bmatrix} 338 & 88.8925 \\ 88.8925 & 33.6247 \end{bmatrix}.$$

Then, the matrix $\mathbf{A}^*$ can be obtained as below:

$$\mathbf{A}^* = \begin{bmatrix} 349.52131 & 92.01022 \\ 92.01022 & 34.83724 \end{bmatrix} \qquad \text{(Based on Equation (5))}$$

The actual relationship among the 99.73% process region, 99.73% revised engineering tolerance region and engineering tolerance region is illustrated in Figure 3.

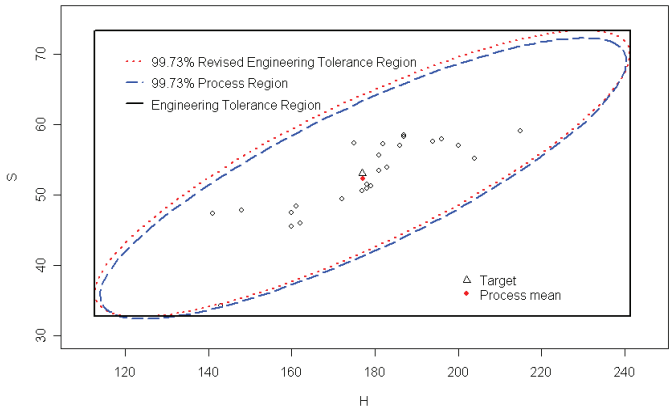


Figure 3. Relationship among 99.73% revised engineering tolerance region, 99.73% process region and engineering tolerance region in example 1.

Apparently, the process mean is close to the target and the "99.73% process region" is approximately equal to the "99.73% revised engineering tolerance region". The comparison results of using various multivariate process indices for estimating the performance of an industrial product are summarized in Table 2. Since the estimated conforming rate for this example is 99.91% under the assumption of multivariate normality for the underlying process distribution and the new indices $NMC_p = 1.0351$ and $NMC_{pm} = 1.0087$, based on Equations (21) and (22) respectively, are nearly equal to 1; which indicates that the 99.73% process region is close to the 99.73% revised engineering tolerance region and the process mean is close to the target (see Figure 3). Thus, the true process performance can be correctly reflected by the new indices NMC_p and NMC_{pm}, i.e. the process is capable. Whereas, the process capability is overestimated by Taam's two new capability indices $MC_p = 1.8751$ and $MC_{pm} = 1.8272$, based on Equations (10) and (2) respectively, since the correlation among multiple quality characteristics are not taken into account. Thus, it is suggested that the new indices NMC_p and NMC_{pm} be used in assessing the likelihood of nonconforming. Furthermore, assuming that the quality loss is \$0.8 per unit when the hardness value is deviated from the target and the quality loss is \$1 per unit when the strength value is deviated from the target, while the quality loss is \$0.89 per unit when both characteristics are deviated from the target, the quality loss matrix can be expressed as：

$$\mathbf{C} = \begin{bmatrix} 0.8 & 0.89 \\ 0.89 & 1 \end{bmatrix}, \qquad \text{(Based on Equation (7))}$$

, $|\mathbf{A}^*| = 3710.48$, $|\mathbf{C}| = 0.0079$ and $k_N = 4.8303$ (Based on the ratio of $(\boldsymbol{\mu} - \mathbf{T})'\mathbf{C}(\boldsymbol{\mu} - \mathbf{T})$ divided by $(\boldsymbol{\mu} - \mathbf{T})'\boldsymbol{\Sigma}^{-1}(\boldsymbol{\mu} - \mathbf{T})$).

Given the multivariate process capability indices $NMC_p = 1.0351$ and $NMC_{pm} = 1.0087$ (as listed in Table 2), the expected quality loss can be estimated by Equation (20), i.e.

$$E(Q) = k_N \left(\left(\frac{NMC_p}{NMC_{pm}} \right)^2 - 1 \right) + \frac{1}{\left(NMC_p \right)^2} \left(|\mathbf{C}| |\mathbf{A}^*| \sum_{j=1}^{2} \frac{1}{|\mathbf{\Lambda}_{(j)}|} \right)$$

$$= 4.8303 \left(\left(\frac{1.0351}{1.0087} \right)^2 - 1 \right) + \frac{1}{(1.0351)^2} \left(0.0079 \times 3710.48 \left(\frac{1}{0.0592} + \frac{1}{462.1942} \right) \right),$$

$$= 0.256 + 462 = 462.256$$

which is the same as the expected loss calculated by Equation (8), i.e.

$$E(Q) = (\boldsymbol{\mu} - \mathbf{T})^T \mathbf{C} (\boldsymbol{\mu} - \mathbf{T}) + tr(\mathbf{C\Sigma}) = 0.256 + 462 = 462.256 .$$

Hence, we demonstrate that the calculation of expected quality loss using the relationship equation between multivariate process capability indices and loss functions is accurate. One advantage of using our proposed relationship equation is that the impact of process capability indices on the $E(Q)$ can be clearly understood by quality practitioners. The other advantage is that the risk assessment conducted in this way can facilitate the sensitivity analysis of risk and then setup a realistic goal for future quality improvement. For example, if the improvement measures successfully applied to the existing process (given that its NMC_p and NMC_{pm} indices have been increased to 1.5), then the expected quality loss can be reduced to $ 220, i.e.

$$E(Q) = k_N \left(\left(\frac{NMC_p}{NMC_{pm}} \right)^2 - 1 \right) + \frac{1}{\left(NMC_p \right)^2} \left(|\mathbf{C}| |\mathbf{A}^*| \sum_{j=1}^{2} \frac{1}{|\mathbf{\Lambda}_{(j)}|} \right)$$

$$= 4.8303 \left(\left(\frac{1.5}{1.5} \right)^2 - 1 \right) + \frac{1}{(1.5)^2} \left(0.0079 \times 3710.48 \left(\frac{1}{0.0592} + \frac{1}{462.1942} \right) \right) = \$220$$

On the other hand, if the management team wants to reduce the quality loss in half, then the team needs to setup a goal for the quality improvement project to bring NMC_p and NMC_{pm} index values up to 1.5. If the continued quality improvement measures have been successfully applied to the existing process (given that both NMC_p and NMC_{pm} indices have been increased to 2.0), then the expected loss will be lowered to only $116, i.e.

$$E(Q) = k_N \left(\left(\frac{NMC_p}{NMC_{pm}} \right)^2 - 1 \right) + \frac{1}{\left(NMC_p \right)^2} \left(|\mathbf{C}| |\mathbf{A}^*| \sum_{j=1}^{2} \frac{1}{|\mathbf{\Lambda}_{(j)}|} \right)$$

$$= 4.8303 \left(\left(\frac{2}{2} \right)^2 - 1 \right) + \frac{1}{(2)^2} \left(0.0079 \times 3710.48 \left(\frac{1}{0.0592} + \frac{1}{462.1942} \right) \right) = \$116$$

Table 2. The basic statistics and multivariate process capability indices in example 1.

Basic statistics for H and S[a]	Process capability indices
Sample Mean for H=177.2	MC_p =1.8751
Sample Mean for S=52.32	MC_{pm} =1.8272
Standard deviation for H=18.385	NMC_p =1.0351
Standard deviation for S=5.799	NMC_{pm} =1.0087
Correlation coefficient between H and S=0.834	

[a] H represents hardness, S represents tensile strength

This numerical example shows that by linking the multivariate process capability indices and multivariate loss function, one can perform the sensitivity analysis between the expected loss and process capability indices. Since the expected loss represents impact and process capability indices reflect the likelihood/opportunity of product failures, the simultaneous consideration of impact and likelihood provides a useful guideline for quality practitioners in performing the correlated risk assessment for any multivariate manufacturing process.

Example 2 Environmental risk assessment using the air pollution data from Song-Shan station.

There are 58 surveillance stations established by EPA of Taiwan to monitor the air quality in Taiwan. Song-Shan is an administrative district in Taipei city; the capital of Taiwan and a domestic airport is located there. It is also well known for a long history of higher pollution in Northern Taiwan region. The air quality data of PM10 and O3 collected by Song-Shan station are discussed since PM10 and O3 have potential threat to health. The recent hourly data were collected by Song-Shan station. In this example, daily average is used and we drop some missing data due to measurement failure. The basic statistics of air pollution data at Song-Shan station are summarized in Table 3. We found that the original air pollution data for PM10 and O3 did not follow a bivariate normal distribution at α=0.05. After performing the Box-Cox normal transformation method proposed by (Andrews et al., 1971), the scatter plot of air pollution data at Song-Shan station shows that the transformed data follows a bivariate normal distribution (see Figure 4). Note that we take an exponent of 0.6248 to the original O3 data and an exponent of 0.1933 to the original PM10 data for normal transformation.

Table 3. The basic statistics of air pollution data at Song-Shan station.

Air Pollutants	Sample means	Std. deviation	Correlation coeff.
O3	24.5204	10.2247	0.2694
PM10	58.6192	26.7534	

The upper specification limit (USL) for O3 stipulated by the EPA of Taiwan is set to the hourly average = 0.12 p.p.m., while the USL for PM10 is set to the daily average = 125 $\mu g/m^3$. After calculating the $MC_{p,pm}$ and $NMC_{p,pm}$ index values for the transformed data, the comparison results of using various multivariate process indices for estimating the O3 and PM10 air pollutants at Song-Shan district are summarized in Table 4.

Table 4. The basic statistics and multivariate process capability indices of O3 and PM10 after normal transformation.

Basic statistics for air pollutants	Process capability indices
Sample mean for O3=7.2240	MC_p =11.6806
Sample mean for PM10 =2.1613	MC_{pm} =1.0392
Standard deviation for O3=1.9514	NMC_p =11.3181
Standard deviation for PM10=0.1938	NMC_{pm} =1.0070
Correlation coefficient between O3 and PM10=0.2472	

Assume that the additional cost per patient due to the increase of respiratory diseases (caused by PM10 and O3 in Song-Shan district) = \$83.36 when only O3 exceeds the USL; an additional cost per patient due to the increase of respiratory diseases =\$53.16 when only PM10 exceeds the USL; and an additional cost per patient due to the increase of respiratory diseases = \$66.45 when both PM10 and O3 exceed the USL, then the environmental loss matrix can be expressed as:

$$\mathbf{C} = \begin{bmatrix} 83.36 & 66.45 \\ 66.45 & 53.16 \end{bmatrix}, \qquad \text{(Based on Equation (9))}$$

and $\left|\mathbf{A}^*\right| = 17.2000$ (Based on Equation (5)) , $\left|\mathbf{C}\right| = 15.8151$, $k_s = 53.2463$ (the ratio of $\boldsymbol{\mu}'\mathbf{C}\boldsymbol{\mu}$ divided by $\boldsymbol{\mu}'\boldsymbol{\Sigma}^{-1}\boldsymbol{\mu}$).

Based on Equations (21) and (22), NMC_p = 11.3181, NMC_{pm} = 1.0070 (as listed in Table 4), then the expected daily environmental loss can be estimated by Equation (23), i.e.

$$E(Q) = k_s\left(\left(\frac{NMC_p}{NMC_{pm}}\right)^2 - 1\right) + \frac{1}{\left(NMC_p\right)^2}\left(\left|\mathbf{C}\right|\left|\mathbf{A}^*\right|\sum_{j=1}^{2}\frac{1}{\left|\boldsymbol{\Lambda}_{(j)}\right|}\right)$$

$$= 53.2463\left(\left(\frac{11.3181}{1.0070}\right)^2 - 1\right) + \frac{1}{\left(11.3181\right)^2}\left(15.8151\times 17.2000\left(\frac{1}{0.0064} + \frac{1}{331.8355}\right)\right)$$

$$= 6673 + 332 = 7005$$

In other words, the average daily cost increase of medical expenses in Song-Shan district in terms of the likelihood of respiratory diseases/multivariate process capability indices = \$7005, which is the same as the expected loss calculated by Equation (8), i.e.

$$E(Q) = (\boldsymbol{\mu} - \mathbf{T})^T\mathbf{C}(\boldsymbol{\mu} - \mathbf{T}) + tr(\mathbf{C}\boldsymbol{\Sigma}) = 6673 + 332 = 7005$$

Note that MC_p = 11.6806, MC_{pm} = 1.0392 (based on Equations (10) and (2) respectively)

are very close to $NMC_p = 11.3181$, $NMC_{pm} = 1.0070$ due to the low correlation coefficient (=0.269) between O3 and PM10. Moreover, significant gaps exist in between $MC_p = 11.6806$ and $MC_{pm} = 1.0392$ as well as in between $NMC_p = 11.3181$ and $NMC_{pm} = 1.0070$, which indicate the existing levels for the air pollutants of PM10 and O3 are much higher than the target level of zero though only a few points exceeding the USL as shown in Figure 4. This numerical example further shows that by linking the multivariate process capability indices and multivariate loss function, the simultaneous consideration of expected loss (represents impact) and process capability indices (reflect likelihood of failure) provides practitioners a useful guideline in performing the correlated risk assessment for any environmental system.

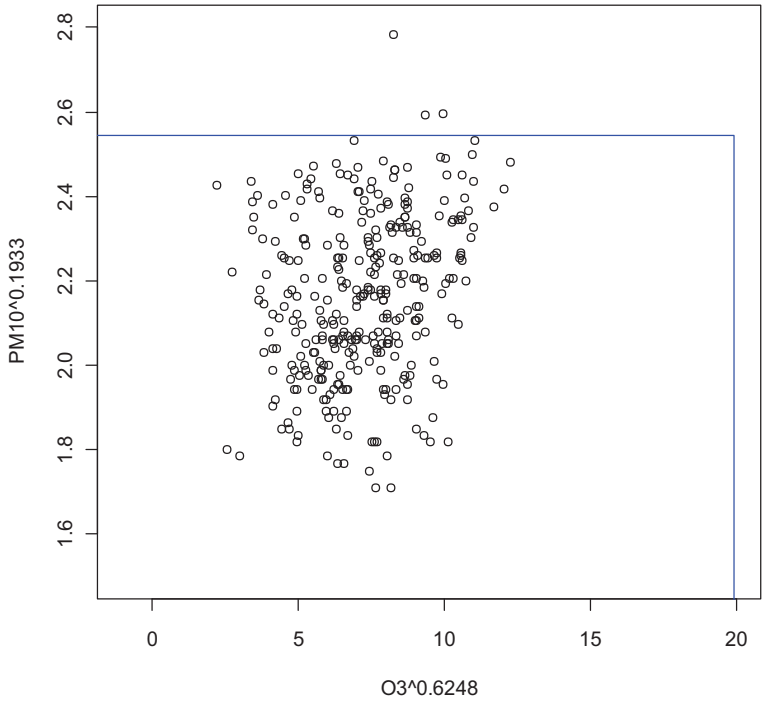


Figure 4. The scatter plot of air pollution data with upper specification limits for O3 and PM10 at Song-Shan station (after normal transformation)

STRATEGIC INSIGHTS AND MANAGERIAL IMPLICATIONS

After obtaining the relevant risk information of likelihood and expected losses from the key multivariate processes, practicing managers and engineers can categorize quality or environmental improvement projects in the following four planning zones of a strategic planning matrix.

(a) Priority zone – high impact (in terms of high expected loss) and high likelihood (in terms of low capability indices).
(b) Long-term zone – high impact and low likelihood (in terms of high capability indices).
(c) Contingency zone – low impact (in terms of low expected loss) and high likelihood.
(d) Non-priority zone – low impact and low likelihood

The strategic planning matrix containing four zones as shown in Figure 5 is used for these assessments.

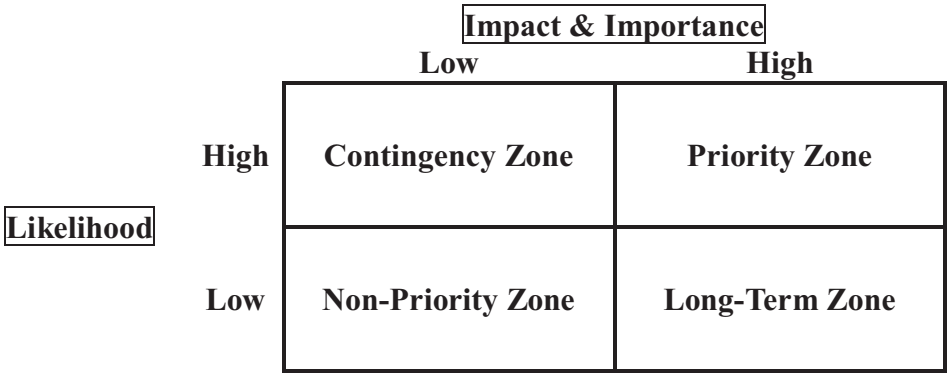


Figure 5. The classification of four planning zones based on the impact and likelihood

It is worthy to note that (1) special attention and immediate corrective action efforts need to be taken if quality improvement projects fall into Priority Zone (2) long-term planning and proactive action efforts shall be taken if quality improvement projects fall into Long-Term Zone (3) contingency plan need to be formulated to cope with the emergent conditions if quality improvement projects fall into Contingency Zone (4) maintain the status quo, i.e. the practitioners do not need to pay too much attention if quality improvement projects fall into Non-Priority Zone.

The risk information of likelihood and expected loss classified into four quadrants helps practitioners to prioritize quality improvement projects when conducting correlated risk assessment for any multivariate process or environmental system. Once the quality improvement projects are prioritized, the new approach of correlated risk assessment can lead to the direction of continuous improvement for any industry.

In terms of industry use, it is unlikely that smaller corporations that have difficulty applying FMEA to their operations could benefit from correlated risk analysis. A commitment to SPC and its processes is the most conducive environment for this advanced process monitoring. As well, industries whose products involve complicated components and assemblies such as aerospace, automotive or military contracting have the most to gain from correlated risk analysis. On the environmental side, chemical processing industries such as petro refineries, steel plants or plastics manufacturing could benefit by verifying that their output of pollutants is well within governmental tolerance and regulation.

CONCLUSIONS

Correlated risk assessment with its emphasis on the loss function is an essential tool for multi-response quality engineering. In this paper, we propose a new approach of correlated risk assessment by linking the multiple process capability indices and loss functions. With the multivariate process capability indices, we have shown that the expected quality loss can be estimated for both the-nominal-the-best and the-smaller-the-better cases. The two numerical examples demonstrate that expected losses can be estimated by various multivariate process capability indices and they show the advantage of using our proposed relationship equations.

The new multivariate process capability indices properly reflect the actual nonconforming rate.

To implement correlated risk assessment in practical applications, existing quality or environmental issues must be identified. Then, Key Performance Indicators (KPIs) and their multivariate process capability indices are developed to quantify the system. At this point risk can be assessed by applying the new relationship equations to evaluate the impact of correlated risk on manufacturing processes, or on multiple environmental emissions, such as SO_2 and NO.

REFERENCES

1. Andrews, D. F., Gnanadesikan, R. and Warner, J. L. (1971), "Transformations of Multivariate Data", *Biometrics*, Vol. 27 No. 4, pp. 825-840.
2. Ayyub, B. M. (2003), *Risk Analysis in Engineering and Economics*, Chapman & Hall/CRC, Boca Raton.
3. Chan, L. K., Cheng, S. W. and Spiring, F. A. (1991), "A multivariate measure of process capability", *International Journal of Modeling and Simulation*, Vol. 11 No. 1, pp. 1-6.
4. Chen, H. (1994), "A multivariate process capability index over a rectangular solid tolerance zone", *Statistica Sinica*, Vol. 4 No. 2, pp. 749-758.
5. Chuang, P. T. (2010) , "Incorporating disservice analysis to enhance perceived service quality", *Industrial Management & Data Systems*, Vol. 110 No. 3, pp. 368-391.
6. Corbett, C. J. and Pan, J. N. (2002), "Evaluating environmental performance using statistical process control techniques", *European Journal of Operational Research*, Vol. 139 No. 1, pp. 68-83.
7. Corbett, C. J. and Van Wassenhove, L. N. (1995), "Environmental issues and operations strategy", in Folmer, H., Gabel, H. L. and Opschoor, H. (Ed.), *Principles of Environmental and Resource Economics*, Edward Elgar Publishing Ltd., Aldershot UK, pp. 413-439.
8. Foster, E. J., Barton, R. R., Gautam, N., Truss, L. T. and Tew, J. D. (2005), "The process-oriented multivariate capability index", *International Journal of Production Research*, Vol. 43 No. 10, pp. 2135-2148.
9. Hubele, N. F., Shahriari, H. and Cheng, C. S. (1991), "A bivariate process of capability vector", in Keats, J. B. and Montgomery, D. C. (Ed.), *Statistical Process Control in Manufacturing*, Marcel Dekker, New York, pp. 299-310.
10. Johnson, R. A. and Wichern, D. W. (2007), *Applied Multivariate Statistical Analysis*, Prentice Hall, Upper Saddle River.
11. KarimiAzari, A., Mousavi, N., Mousavi, S. F. and Hosseini, S. (2011), "Risk assessment model selection in construction industry", *Expert Systems with Applications*, Vol. 38 No. 8, pp. 9105-9111.
12. Kenchakkanavar, V. D. and Joshi, A. K. (2010), "Failure Mode and Effect Analysis: A Tool to Enhance Quality in Engineering Education", *International Journal of Engineering*, Vol. 4 No. 1, pp. 52-59.
13. Kolarik, W. J. (1995), *Creating Quality: Process Design for Results*, McGraw-Hill, New York.
14. Madu, C. N. (1996), *Managing Green Technologies for Global Competitiveness*, Quorum Books, Westport.
15. Madu, C. N. (2004), "Achieving competitive advantage through quality and

environmental management", *Journal of Environmental Quality Management*, Vol. 14 No. 2, pp. 59-76.
16. Montague, D. F. (1990), "Process risk evaluation-what method to use? ", *Reliability Engineering and System Safety*, Vol. 29 No. 1, pp. 27-53.
17. Nassimbeni, G., Sartor, M. and Dus, D. (2012), "Security risks in service offshoring and outsourcing", *Industrial Management & Data Systems*, Vol. 112 No. 3, pp. 405 - 440.
18. Pan, J. N. (2007), "A new loss function-based approach for evaluating manufacturing and environmental risks", *International Journal of Quality and Reliability Management*, Vol. 24 No. 8, pp. 861-887.
19. Pan, J. N. and Lee, C. Y. (2010), "New capability indices for evaluating the performance of multivariate manufacturing processes", *Quality and Reliability Engineering International*, Vol. 26 No. 1, pp. 3-15.
20. Pignatiello, J. J. (1993), "Strategies for robust multiresponse quality engineering", *IIE Transactions,* Vol. 25 No. 3, pp. 5-15.
21. Sultan, T. L. (1986), "An acceptance chart for raw materials of two correlated properties", *Quality Assurance*, Vol. 12 No. 3, pp. 70-72.
22. Taam, W., Subbaiah, P. and Liddy, J. W. (1993), "A note on multivariate capability indices", *Journal of Applied Statistics*, Vol. 20 No. 3, pp. 339-351.
23. Vilko, J. P. P. and Hallikas, J. M. (2011), "Risk assessment in multimodal supply chains", *International Journal of Production Economics*, In Press, Available online 21 September. (DOI:10.1016/j.ijpe.2011.09.010)
24. Wang, F. K. and Chen, J. C. (1998), "Capability index using principal component analysis", *Quality Engineering*, Vol. 11 No. 1, pp. 21-27.
25. Wang, F. K. and Du, T. C. T. (2000), "Using principal component analysis in process performance for multivariate data", *Omega*, Vol. 28 No. 2, pp. 185-194.
26. Wang, F. K., Hubele, N. F., Lawrence, F. P., Miskulin, J. D. and Shahriari, H. (2000), "Comparison of three multivariate process capability indices", *Journal of Quality Technology*, Vol. 32 No. 3, pp. 263-275.
27. Wang, X., Chan, H. K., Yee, R. W. Y. and Diaz-Rainey, I. (2012), "A two-stage fuzzy-AHP model for risk assessment of implementing green initiatives in the fashion supply chain", *International Journal of Production Economics*, Vol. 135 No. 2, pp. 595-606.
28. Wang, Y. M., Chin, K. S., Poon, G. K. K. and Yang, J. B. (2009), "Risk evaluation in failure mode and effects analysis using fuzzy weighted geometric mean", *Expert Systems with Applications*, Vol. 36 No. 2, pp. 1195-1207.

The full name and details of the corresponding author

Author 1 Name: J. N. Pan[a]

[a]*Department of Statistics, National Cheng-Kung University, Tainan, Taiwan, 70101, ROC*

Postal address: No.1, University Road, Tainan City 701, Taiwan (R.O.C.)

E-mail address: jnpan@mail.ncku.edu.tw ;Tel: +886 6 2757575

Author 2 Name: Sheau-Chiann Chen[b]

[b] Department of Applied Mathematics, National Chiayi University, Chiayi, Taiwan 60004, ROC

E-mail address: scchen@mail.ncyu.edu.tw

Biography

Dr. J.N. Pan is currently served as a Vice Dean at College of Management, National Cheng Kung University. Professor Pan's expertise is in the fields of quality management, industrial statistics and decision science. He has authored two textbooks in quality management and published over 70 papers both in domestic and international journals. He holds M.S.-I.E. and Ph.D. degrees from Texas Tech University in Lubbock, Texas. He is an ASQC-certified Quality and Reliability Engineer. He has received several distinguished awards including Research and Teaching Excellence awards from NCKU, four best paper awards from Chinese Society for Quality, etc.

Dr. S.C. Chen is an assistant professor at Department of Applied Mathematics, National Chiayi University. Her research interest is in the fields of statistical quality control and applied statistics.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

POPULAR ONLINE PROMOTION STRATEGIES AMONG DIFFERENT INDUSTRIES

Chin-Shan Wu, Department of Information Management, Tunghai University, Taiwan, ROC
Email: cswu.mis@gmail.com

Yi-Ting Huang, Institute of Technology Management, National Chung Hsing University, Taiwan R.O.C.
Email: g100026110@mail.nchu.edu.tw

Fei-Fei Cheng, Institute of Technology Management, National Chung Hsing University, Taiwan R.O.C.
Email: feifei.mis@gmail.com

ABSTRACT

Purpose: *The objective of this study is to explore what types of sales promotions are frequently used by online stores from different industries.*
Design/methodology/approach: *The content analysis were conducted based on the data collected from four industries : online music service provider, Internet bank, automobile website, and TV channels website. Online sales promotion activities from ten websites in each industry were collected, resulting in 40 websites to serve as sample website. An online sales promotion framework which includes ten popular sales promotion strategies was proposed based on previous studies to serve as the basis of content analysis.*
Findings: *Contests and sweepstakes is the most popular online promotion strategy used by all the selected websites, followed by patronage awards, price-offs, and free gifts are also confirmed as the frequently used promotion strategies on the Internet. The results also revealed that, for music website, price-off is the most popular sales promotion strategies. Contest & sweepstakes and patronage awards are prevalent for Internet banks. In addition, product warranty is the most frequently used promotion strategy in automobile industry. Finally, contest & sweepstakes promotion is the only one that is frequently adopted by TV channel websites.*
Practical implications: *The online promotion classification framework suggested in current study provided a reference for practitioners to understand the possible online sales promotion strategies to choose. Further, current study provides information regarding the popularities of online sales promotion across different industries. Thus, business owners can take the industrial characteristics into consideration when choosing the appropriate promotion strategies.*
Originality/value: *As most previous studies mainly discussed different types of online sales promotion strategies, current study is one of the limited research that addressing the online promotion strategies used by different industries. The results indicated that different industries adopted different online promotions because of industries characteristics.*

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

INNOVATIONS IN HIGHER EDUCATION SYSTEM, BASED ON THE EXAMPLE OF THE FACULTY OF ECONOMICS, MARIA CURIE-SKŁODOWSKA UNIVERSITY, PROJECT SYNERGIA CASE

Prof. Agnieszka Sitko-Lutek, Departament of Economics, Maria Curie-Skłodowska University in Lublin, Poland
e-mail: agnieszka.sitko-lutek@poczta.umcs.lublin.pl

M.Sc. Aneta Karasek, Departament of Economics, Maria Curie-Skłodowska University in Lublin, Poland
e-mail: aneta.karasek@poczta.umcs.lublin.pl

ABSTRACT

Purpose: *The work will aim at analyzing the system of higher education in Poland, in the context of global economy and our membership in the EU. Both strong and weak sides of the Polish educational system will be identified against the background of other countries. The study will present good practice regarding the improvement of the practical aspect of competences acquired by the students of the Faculty of Economics at Maria Curie-Skłodowska University in Lublin due to the project called "SYNERGY - Shaping the competences of the students of the Faculty of Economics , UMCS, through acquiring practical knowledge".*
Design/methodology/approach: *This paper has been based on analysis of educational system in Poland. It includes a case study of project Synergia, which aim is shaping the competences of the students of the Faculty of Economics , UMCS, through acquiring practical knowledge.*
Findings: *Building bridge between science and business, acquisition of practical competencies and improvement of specialist competencies could lead to better preparing students to find job when they graduate. Information which competences are required on labour market is also valuable for them to participate in specific trainings. All this activities are implemented in Project Synergia and can improve the situation on labour market.*
Originality/value: *The authors present detailed information and results of project.*

Keywords: higher education, innovations, competences, students, educational system
Classification: Case study

INTRODUCTION

The development of higher education system and courses of studies which would meet requirements and challenges of modern world fulfils a significant role in the process of shaping knowledge-based economy. As a result of growing tendencies for globalisation and integration, the potential and quality of higher education system constitute vital factors of socio-economic and cultural growth and boosting competitiveness of countries and regions as well. As a result of these processes a growing number of publications in one language are published and growing mobility of students and academic staff is observed. At the same time unification of studying processes takes place visible in e.g. the English model of bachelor, master's and doctoral studies.

The fundamental conditioning of higher education systems is the economic context. Greater financial resources translate into a greater degree of independence in shaping educational offer, developed infrastructure and possibility of employing the best academic teachers. (Keller 2006; OECD 2009).

Globalisation is also visible as regards universities' educational function. In recent years the number of students studying outside their country of origin has increased. This ability to attract foreign students testifies to attractiveness and competitiveness of universities.

The above mentioned processes of globalisation constitute a considerable challenge for Polish universities who must compete on the global market of educational services.

The process of globalisation poses numerous challenges for universities. Graduates ought to be prepared for competing on the global labour market, ought to possess knowledge and skills allowing them to undertake employment in any country. The analysis of advantages and disadvantages of education system in Poland revealed that when compared with other countries, there is still room for improvement. Realisation of innovative projects at universities provides opportunities for the perfection of the process of education.

When joining the EU on 1st May 2004, Poland became the signatory of the Bologna Declaration as well. The Bologna Declaration is a document defining all activities and task leading to the unification of education system across European countries. The main objective of the declaration is the development of the European Higher Education Area until the end of 2010, in which students can choose from a wide and transparent range of high quality courses and benefit from smooth recognition procedures.

EDUCATION SYSTEM IN POLAND

In Poland, the main statute concerning higher education system is the bill on higher education system from 27th July 2005. Universities (apart from those headed directly by specified ministries) are supervised by the Ministry of Science and Higher Education.

OECD Report[1] highlights strong and weak sides of the Polish educational system. This research based on cross country analyses and the strong sides are:

- large number of PhD students in Polish tertiary institutions,
- there are a number of positive developments regarding the links between the tertiary education system and the labour market,
- good examples of partnership between institutions and industry,
- career placement and advisory services appear to be available for students in the most Polish tertiary institutions.

[1] Fulton O., Santiago P., Equist Ch., El-Khawas E., Hackl E. (2007), OECD Review of Teriary Eduaction,Poland, OECD 2007.

The weak sides of Polish educational system are:

- low level of public spending on R&D (higher education expenditure on R&D as a percentage of GDP in 2005 was 18 position in ranking of 19 OECD countries),
- annual expenditure per student by educational institutions in primary through tertiary education in Poland rank among the lowest and amount to 5135 USD, with average in OECD countries 8354 USD. In USA, on the other hand, these expenditures amount to 14923 USD[2],
- limited patenting activity.

A SWOT analysis of education sector outlined in 2007-2013 Strategy for the Development of Education indicates strong and weak areas of education in Poland. Among the assets one can find: a large number of universities which vary as regards their educational offer, high gross enrolment ratio, low percentage of 18-24 years-old dropouts in relation to the number of students in the education system, system of financial assistance for students, more than tripled number of students gaining PhD degrees, autonomy of universities. The disadvantages of the system include: low percentage of students of mathematics, natural sciences and technology in the total number of university graduates, weak relationship of science and higher education with economy and labour market, insufficient utilization of R&D potential of universities, ineffective university management system, teaching curricula not fit for preparing students for entering labour market, low percentage of students of further education (underdeveloped system of further and distance education), relatively low expenditures per student in USD as regards the purchasing power. Advantages include: relatively young age structure of the population; increase in the number of the well-educated entering labour market; low regional discrepancies as regards primary, middle and secondary education, strong position of exact sciences and achievements in some of the applied sciences (e.g. medicine, programming); relatively low cost of work as compared with the EU[3].

Poland as a member of EU prepare National Cohesion Strategy for 2007-2013, which a strategic objective was formulated as a result of an analysis, including the analysis of higher education system, which indicated discrepancies in the level of socio-economic development of the country and its regions as compared with other EU countries. The objective will be accomplished by the implantation of Operational Programmes co-financed by the EU. National Cohesion Strategy outlines such disadvantages as: insufficient ties between education system and labour market, high unemployment rate, especially among the youth, women and the unqualified, insufficient promotion of entrepreneurship among citizens in the course of education. In education area one of the weak side is poor level of practical competences of students which lead to high young unemployment. Unemployment rate of young under 25 in March 2013 in Poland was 28,1%, but the EU average was 23,6%[4].

In 2007-2013, the Ministry of Science and Higher Education serves as the Intermediate Body for three operational programmes: Innovative Economy, Human Capital and Infrastructure and Environment. 4,1 billion EUR is available in the framework of these programmes. The amount will be allocated to development and modernisation of universities, research infrastructure, R&D projects, maintaining the high level of education and increasing the

[2] Education at a Glance 2011: OECD Indicators.
[3] Strategy for the Development of Education, Ministry of National Education and Sport, 2005.
[4] Data come from Eurostat Datebase.
http://epp.eurostat.ec.europa.eu/portal/page/portal/employment_unemployment_lfs/data/database

overall number of students of courses which ensure attractive employment opportunities. Polish entrepreneurs have the opportunity for acquiring funds to be used for the development of cooperation with research sector. On the basis of students' requirements analysis and opportunity for funding "Synergia" project was introduced.

The structure of unemployment by education shows that employing a large part of the unemployment is not possible, because in current institutional conditions and the characteristics of the current economy, they have inadequate employment to those qualifying equipment[5].

PROJECT SYNERGIA

In order to meet graduates' and employers' requirements the realisation of the project titled "SYNERGY - Shaping the competences of the students of the Faculty of Economics , UMCS, through acquiring practical knowledge" was started. The project is co-financed by the European Union under the European Social Fund under the Operational Programme Human Capital (OP HC) and will be realised at the Faculty of Economics of the MCSU in Lublin in the period between October 2010 and September 2014.

The main objective of the project is bridging the competence gap among graduates of the faculty by improving the practical aspect of education for 1120 students.

The particular aims of the project include:

- strengthening practical elements of teaching through initiating and developing the Faculty's collaboration with enterprises and institutions,
- organizing on-the-job training courses and internships for university students,
- creating the Council of Entrepreneurs as an advisory organ for the Program Council of the Faculty of Economics, UMCS,
- university classes taught by practitioners,
- implementing by students practical projects in enterprises and institutions, under the supervision of research assistants,
- enhancing knowledge of mathematics in students of the first year of full-time university courses, 1st cycle, at the Faculty of Economics, UMCS, through their participation in remedial courses,
- preparing the graduates more efficiently for their entering the job market, through offering interpersonal training courses and courses in starting and running business activities,
- facilitating the contact of our students with potential employers, through organizing panel meetings with representatives of enterprises and institutions, as well as workshops.

All students undertaking education at the faculty in the period of running the project can apply for support in its framework and at the end of 2012 in project participated 1,820 university students.

[5] Thieme J.K. (2009), Higher education. Challenges of XXI century. Poland, Europe, USA, Difin, Warsaw, pp.276.

The project has been running at the Faculty of Economics of Maria Curie Skłodowska University in Lublin since October 2009. In the framework of the project, a variety of activities are undertaken all aiming at improving the practical aspect of education. It seems relevant to enumerate the most important among these and their results achieved until the end of 2012.

In the framework of the project, activities have been undertaken in the following areas:

- business-science cooperation,
- acquisition of practical competencies,
- improvement of specialist competencies,
- popularisation of project's results.

Detailed actions undertaken in these areas will be presented below.

Business science cooperation

In order to link the process of education at the MCSU Faculty of Economics and R&D undertakings more closely with business practice, a Business Committee was established. The committee consist of distinguished managers of businesses and financial institutions and heads of professional and self-government associations.

The mission of the Business Committee is the establishment of a cooperation platform between domains of science and business practice which would lead to the effective utilisation of available resources as regards socio-economic development of the region[6].

The Committee assumed the accomplishment of the following objectives as the aim of their operation:

1. Exchange of information and experiences in the area of science and business practice.
2. Initiating mutually beneficent activities and issuing opinions on proposed projects.
3. Organisation of joint undertakings as regards partners' standard operations or realising public interest [7].

Entities interested in assistance as regards solving problems present in their business or institution may obtain such assistance in the framework of "Synergia" project. Such activities are realised in the framework of practical projects where students working in task forces under supervision of coordinators put forward resolutions to the problem. From the point of view of employers the exercise seems valuable because such solutions are innovative, cost free and frequently contribute to solving the problem. 133 students took part in practical projects in companies since the beginning of running the project until the end of 2012.

Another form of business-science cooperation is the provision of internships in businesses and institutions. Entities interested in offering practical trainings and internships can submit their offers along with their requirements. As a consequence, the entities are entered into the database of organisations cooperating with the MCSU in the framework of SYNERGIA project. Next, based on their own preferences and requirements, students apply for the internship. Upon completion of the recruitment process the candidate is qualified to

[6] http://www.umcs.lublin.pl/articles.php?aid=6550&mid=13&mref=39990
[7] http://www.umcs.lublin.pl/articles.php?aid=6550&mid=13&mref=39990

participate in the internship and the internship agreement is signed. 426 students participated in practical trainings held by businesses and institutions and 13 graduates participated in paid internships since the beginning of running the project up to the end of 2012.

In order to adjust teaching curricula to the requirements of labour market, research regarding the level of graduates' competencies compatibility with labour market's requirements is conducted regularly. In order to identify employers' opinions as regards the graduates of the Faculty of Economics such research methods as survey questionnaire, statistical analysis and focus group interviews are used.

A survey was carried out with the use of the Virtual Cooperation Platform of the MCSU Faculty of Economics (VCPFE) by means of a questionnaire. Research carried out in the framework of the project indicated, on employers' part, the necessity of improvement of graduates' practical preparation. In addition, among the students' competencies' components, domain knowledge and skills require improvement. According to employers' recommendations and opinions, graduates lack practical knowledge and skills. However, the tendency seems lower as compared to results of research conducted in 2009/2010 academic year[8].

Acquisition of practical competencies

Research conducted in the framework of the project indicates that practical knowledge and skills are extremely desired by employers.

In order to acquire practical competencies students participate in practical projects contracted by businesses and institutions. This is aimed at providing students with the opportunity of becoming familiar with specific aspects of consulting work and provide setting for applying their knowledge into solving particular problems of the entities as regards their operations. Students work in task forces headed by coordinators where they work on their individual projects. Individual teams' results are presented during a public presentation and evaluated by managers, executives and heads of the company/ institution who select projects with the greatest potential for practical application. Owing to the participation in such practical projects, students gain the opportunity of presenting their own knowledge, skills and predispositions to employers, which constitutes a valuable source of information on prospective employees.

Students of the MCSU Faculty of Economics can acquire these by participating in free-of-charge training and paid internships. Almost 400 offers are available every year. Such offers are continually updated. If need be, when participating in trainings and internships, students can rely upon assistance of the project staff.

Realisation of practical projects where students solve existing problems of businesses and institutions provides them with the opportunity of becoming familiar with realities of the economy and its requirements. As a consequence, students realising practical projects apply their knowledge in practice and improve their skills.

[8] Karasek A., Grela G. (2012), Report on the analysis of information on level of graduates' competencies of the Faculty of Economics compatibility with labour market's requirements, Lublin, pp.26.

Objectives of the project are accomplished by holding classes conducted by experts. For the duration of the project, such classes, under the name "Practical aspects of entrepreneurship" have been introduced into the curriculum of the following undergraduate courses: Economics, Management and Finances, Finances and Accounting. Classes are held by various experts and are tailor-made for the particular course. 931 students participated in such classes since the beginning of running the project until the end of 2012.

Improvement of specialist competencies

The project also offers assistance to freshmen whose knowledge of mathematics is insufficient. "Remedial Courses of Mathematics" are specially designed for them. The course lasts 25 hours. 255 student participated in such courses until the end of 2012.

Trainings constitute yet another form of support offered in the framework of the project. Initially, two trainings were planned: "Establishment and running a business" and "Interpersonal Training". Every year, the offer is supplemented with additional two trainings as requested by students. Up to now, besides the above-mentioned, the following trainings were organised: "Computer Accounting" (3 editions), "Decision-Making Simulation" (1 edition), "Stock Exchange Investments" (1 edition). 289 students participated in these trainings since the beginning of running the project until the end of 2012.

Popularisation of project's results

The realisation of the project is supported by a Virtual Cooperation Platform of the MCSU Faculty of Economics (VCPFE) which serves as a virtual meeting place for students, faculty members, businesses, business environment institutions and self-government bodies as regards exchange of information on: practical projects' realisation. participation in internships and employment services.[9] Until the end of 2012 there were 2901 active users of the platform[10].

Users of the VCPFE can be divided into the following groups:

- students of the MCSU Faculty of Economics- including present and prospective graduates of the faculty,
- faculty members- employees of universities expressing willingness to participate in the project,
- businesses- employers, owners, business environment institutions,
- monitoring bodies- including project teams' members, project's administration staff[11].

Project's stipulations were presented during the opening conference. Representatives of businesses and institutions, university faculty members and students were among the participants. As a result of the discussion it was agreed that the development of mechanisms for systematic exchange of experiences and knowledge transfer between businesses and universities will constitute the key aspect of cooperation. The initiated joint activities

[9] Wiechetek Ł., Supporting the cooperation between science and business with the use of e-learning tools on the project Synergia ex ample [in:] Information technology in practice, M. Miłosz (editor), Polish Informatic Society, Lublin 2010, pp.28.
[10] Own data.
[11] Wiechetek Ł., Supporting…, *op.cit.,* pp.30-31

contributed to the improvement of cooperation of businesses and institutions with universities. The cooperation will prove beneficial for elevating the level of student's practical competencies and students' preparation for entering labour market.

3rd Gala of Science and Business organised jointly by the MCSU Faculty of Economics and Lublin Confederation of Private Employers- Lewiatan constituted an extension to the conference. At the Gala, "Gold Course Record Books of Business" were awarded in three categories:

1) The Best Internship Provider;
2) Perfect Employer;
3) The Most Pro-Student Company

The "Gold Course Record Books of Business" is an award given by the MCSU Faculty of Economics students to distinguishing businesses and institutions as regards their openness towards students' needs in terms of improvement of competencies. The idea of the award arose in the framework of "Synergia" project.

In order to develop a multi-disciplinary platform for the exchange of knowledge in the areas of services, engineering, business, management, education and social sciences in the area of synergy the "International Journal of Synergy and Research" was established. Synergy seems to be the main expected factor of different business and/or social activities in contemporary, networked, electronic, interconnected, real-time, knowledge-based economy.

Professor Binshan Lin from Louisiana State University (Shreveport, USA) was appointed as the content-related consultant of the project. Professor Lin's participation in the project provides high-quality contend-related assistance for its realisation. Professor Lin assistance guidance is available as regards publication of papers in international journals, including those listed in ISI and JCR. Moreover, Mr. Lin presented American experiences in the domain of business-science cooperation and commercialisation of research results. Examples of good practices concerning business- science cooperation originating from higher education system in USA proved invaluable.

"Synergia" project has been awarded four times by the Ministry of Science and Higher Education and the National Centre for Research and Development. The ministry considers the project as novel, innovative and distinguishing from among other educational projects realised in the framework of Human Capital Operational Programme. The ministry appointed the project as the model to be presented to reporters in the framework of STUDY TOUR (16.11.2010) and then featured in a national newspaper (Gazeta Wyborcza; June 2011). As one out of eight national projects, "Synergia" project was presented in the catalogue titled "The Innovative 2011" which promotes projects co-financed by the EU.

SUMMARY

In order to meet requirements of globalisation and knowledge-based economy and also growing competitiveness among universities, a variety of activities are undertaken, but innovation of education deserves more attention among these.

Building bridge between science and business, acquisition of practical competencies and improvement of specialist competencies could lead to better preparing students to find job when they graduate. Information which competences are required on labour market is also valuable for them to participate in specific trainings. All this activities are implemented in Project Synergia and can improve the situation on labour market. A summing-up conference is foreseen to conclude the project. Representatives of businesses and institutions, academic staff and students from Poland and other countries will be in attendance. The conference will be devoted to the exchange of points of view and experiences concerning business-science cooperation, financing this cooperation, the issue of clusters in economy, requirements of employers as to graduates of courses of economics, evaluation of their competencies and methods of meeting these requirements. There will be also possibility to discuss about the expectations of employers to graduates in economics and evaluation of their level of competence.

REFERENCES

1. Ascente D. (2010), Literature review: a representation of how future knowledge worker is shaping the twenty-first century workplace, "On the Horizon, Vol. 18, No. 3, pp. 279-287.
2. Atkinson S. (1999), Reflections. Personal development for managers – getting the process right, "Journal of Managerial Psychology", Vol. 14, No. 6, pp. 502-511.
3. Biagi F., Lucifora C. (2008), Demographic and education effects on unemployment in Europe, "Labour Economics", 5, pp. 1076-1101.
4. Bohlinger S. (2007), Competences as the core element of the European Qualifications Framework, "European Journal of Education", Vol. 42, No 4, pp. 96-118.
5. Cardoso A. R. and others (2008), Demand for Higher Education Programs: The Impact of the Bologna Process, "CESIfo Economic Studies", 54 (2), pp. 229-247.
6. Fulton O., Santiago P., Equist Ch., El-Khawas E., Hackl E. (2007), OECD Review of Teriary Eduaction,Poland, OECD 2007.
7. Howells J., Ramlogan R., Cheng S. L. (2012), Innovation and university collaboration: paradox and complexity within the knowledge economy, "Cambridge Journal of Economics", vol. 36, issue 3, pp. 703-721.
8. Karasek A., Grela G. (2012), Report on the analysis of information on level of graduates' competencies of the Faculty of Economics compatibility with labour market's requirements, Lublin, pp.26.
9. Keller K., 2006, „Investment in primary,secondary, and higher education and the effects on economic growth", Contemporary Economic Policy, nr 24(1).
10. Mechtenberg L., Strausz R.(2008), The Bologna process: how student mobility affects multi-cultural skills and educational quality, "International Tax and Public Finance", vol. 15, issue 2, pp.109-130.
11. Neumann G., Olitsky N., Robbins S. (2009), Job congruence, academic achievement, and earnings, "Labour Economics", 16, pp. 503-509.
12. Powell J. J.W., Solga H. (2008), Internationalization of vocational and higher education systems: a comparative-institutional approach, Discussion Paper SP I 2008-501, Social Science Research Center Berlin (WZB), pp. 5-35.
13. Sitko-Lutek A., Jakubiak M. (2012), Competencies of university graduates from economics and management, as perceived by university students and employers – research report, [in:] V. Dermol, N. Trunk Širca, G. Dakovic, U. Lindav (eds.),

Knowledge and Learning: Global Empowerment, Proceedings of the Management, Knowledge and Learning International Conference 2012, International School for Social and Business Studies, Celje, Slovenia.
14. Sitko-Lutek A., Jakubiak M. (2011), The competences of the students of business regarding the process of creating human resources, [in:] V. Dermol, N. Trunk Širca, G. Dakovic, U. Lindav (eds.), Knowledge as Business Opportunity, Proceedings of the Management, Knowledge and Learning International Conference 2011, Celje, Slovenia.
15. Sitko-Lutek A., Jakubiak M. (2011), Business students competences self evaluation in the contents of labor market requirements, "Organisation and Management" (13), s. 91-104.
16. Strategy for the Development of Education, Ministry of National Education and Sport, 2005.
17. Thieme J.K. (2009), Higher education. Challenges of XXI century. Poland, Europe, USA, Difin, Warsaw.
18. Tomlinson M., Graduate employability and student attitudes and orientations to the labour market, "Journal of Education and Work" 2007, Vol. 20, No. 4, s. 285-304.
19. Wiechetek Ł. (2010), Supporting the cooperation between science and business with the use of e-learning tools on the project Synergia ex ample [in:] Information technology in practice, M. Miłosz (editor), Polish Informatic Society, Lublin, pp.28.
20. Wiechetek Ł. (2011), Using an e-learning tools to support cooperation between science and business. Case of Synergy project, conference materials, Management, Knowledge and Learning International Conference 2011. Knowledge as Business Opportunity, Celje, Slovenia, 22-24 June 2011 r., pp. 203-212.
21. Wuttig S. and others, The Bologna Process: Stocktaking and Prospects, Directorate General for Internal Policies, Policy Department, Structural and Cohesion Policies, 2011, pp. 3-4.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

INNOVATIONS IN THE CONTEXT OF THE RISK MANAGEMENT

Anna Karmańska, Warsaw School of Economics, Poland
Email: akarman@sgh.waw.pl

Tomasz Michalski, Warsaw school of Economics, Poland
Email: tomich@sgh.waw.pl

Adam Śliwiński, Warsaw School of Economics, Poland
Email: asliwin@sgh.waw.pl

ABSTRACT

Modern companies seeking to increase in the value have to be innovative. This is because innovation is an attribute of a knowledge-based economy, the competitiveness of enterprises, the market value of the company's growth and the challenge for many industries, not just those who are exposed to rapid technological progress. Innovations are a necessity component in products, processes and business model of the organization, logistics, environment and marketing. Human capital is a key factor in that component which. The paper refers to risk management of the innovative company. The authors ask a question: What determines limits of innovation and what fields of management are key elements of success? Two fields are identified: cost management of innovation process and insurance connected to that process. Background for the deliberations undertaken is knowledge based management of innovative company.

INTRODUCTION

Business activity conducted in any place and at any time is risk related. What is characteristic of a "given place and time" is the specificity of the risk factors, the risk level as well as the availability of tools to manage this risk.

The era of knowledge based economy, which the world enters dynamically, reveals many new factors and necessities which a modern company needs to consider and cope with if it wishes to continue its activity. A significant area of factors which are significant here is the innovativeness of activity, in a broad meaning of the word. Innovativeness is a sign of the era of the knowledge based economy and what is characteristic of this era is the fact that its "soft" borders are marked only by business ethics. Holistically, one may ask about the borders of innovation introduced into business. Are they determined by:

- actual needs of end consumers and as a consequence needs (demand) of companies participating in the chain of value delivered to these customers or first of all
- actual "needs of earning" on investments in companies from the chain of value for customers?

This paper does not attempt to answer this question. It analyses the problem of management of innovation programmes and projects introduced by individual companies from the microeconomic perspective. Bearing this in mind, it is necessary to distinguish three areas to focus on in an innovative company:

A) knowledge management and diagnosis of innovation potential,
B) innovation cost management,
C) innovation management in the risk conditions.

Innovations, i.e. something new, with no standard set before or only to a certain extent based on well-known models and solutions in each of the aforementioned areas give rise to a specific **uncertainty** in business activity. Thus, the undertaking of the innovation activity should be preceded by an attempt to identify the risk factors, which may allow for its limitation once identified within this uncertainty. Knowing the risk factors one may undertake attempts to manage in risk conditions, which grossly simplified may be understood as the application of preventive instruments and solutions focused on identified risk factors and thanks to it preventing the potential implementation of risk with effects of the scale initially predicted or refunding the incurred losses as a result of the implementation of this risk.

I. Knowledge management and innovation potential diagnosis

Innovations always require a new ”knowledge” and high ”organisational efficiency.” Thus, they are stuck in the corporate ”intellectual capital” (human, organisational and relative). Innovations may occur only in those companies where this capital actually exists and is reflected in the competences of the managerial staff.

Presently, one of the innovation underlying skills is the so-called knowledge engineering or data mining. This skill consists in the ability to reveal the knowledge hidden 2 in different sources of scattered data, e.g. in databases and may have a great impact on the decision to undertake an innovation process and to determine the way of its implementation.

In the context of innovation, the acquisition of a broadly perceived new knowledge is only one of the aspects of the corporate knowledge management. Another aspect to be considered is the assessment efficiency skill: (1) its business usefulness, (2) risk related to its potential application, (3) advantages resulting from its application. The skill is a starting point for the launch of the innovation process. For this reason it is indispensable to **recognise the corporate innovation potential**, at least in these areas of competence. It is a prerequisite for the innovation process management when this process is accompanied by uncertainty and different risk factors, which is discussed later.

II. Innovation cost management

From the microeconomic perspective, disregarding the reason for innovation activities, it may be effortlessly stated that ”business success” measured for example with the growth in market value is achieved by the companies which accurately prepare their innovations. The very idea of innovation is not enough though it is a driving mechanism of the whole innovation project. The innovation, if it is to work, needs to be implemented, and this is connected with costs related to the innovation undertaking. At present, when it is generally claimed that a company is a source of costs not incomes, the **development of corporate competence within the innovation cost management is crucial**. The discussion below presents the authors’ self-designed approach to the problem of innovation cost management in an individual company.

In the area of innovation undertaking cost management the risk factors are found on two cost planes: *ex ante* (planned costs) and *ex post* (incurred costs). In order to identify these factors it is necessary to:

(1) define the cost object appropriate for the adopted notion of innovation,
(2) define the cost model which will determine the information structure of innovation undertaking costs,
(3) set the system of records of the incurred innovation costs and the system of controlling,
(4) set the method of monitoring of innovation undertaking cost effectiveness in the course of the whole period of the "innovation effect."

Re. 1)
The definition of the **cost object** is derived from: (1) the corporate perception of innovation, (2) the ability to classify innovations according to their kinds as well as (3) the identification of the innovation process stages and (4) activities conducted during these stages.
From the microeconomic perspective, **innovation is a solution suitable for business application and constituting a novelty, at least from the perspective of the company launching this solution.**[1]

The definition of the cost object does not need to consider classifications based on their importance. It is not significant whether it is a breakthrough, original or imitative innovation. What is important is the criterion of the field of innovation which may be the company's 3 product offer, a process conducted in the company or the organisation of selected activity and the process of reaching the introduction of changes within these innovation fields.

Bearing this in mind, the starting point in considerations of the innovation process cost may be the material presented below (Table 1), which is at the same time a demonstration of the features of (components) of the cost object under discussion.

[1]Innovation notional review according to among others: J.Schumpeter (early 20th century), Programme for better economic competitiveness of the EU member countries (called the Lisbon Strategy) (2000), S.Stern, M.Poter, J.L. Furman, Oslo methodology and the Polish Central Statistical Office, Guidelines of the Ministry for economy and Labour for the needs of the Polish Agency of Development of Competitiveness (PARP), see: M.Boniecki, R.Grabowski (2007), *Parametry charakteryzujące innowacje (Parameters characteristic of innovation)*, [in:] A.Karmańska (ed.) *Zarządzanie kosztami jakości, logistyki, innowacji, ochrony środowiska (Quality, logistics, innovation and evironmetal protection cost management)*, Difin 2007, pp. 120-129.

Table 1. Phases, stages and activities as drivers of costs in cost object implementation – innovation process

Cost drivers of a cost object – innovation process				
Kind of innovation: product – process – organisational	Phase	Stage	Cost characteristics	Activity
	FI. Research	EI.1. conceptualisation of research	the costs of activity implementation including the planning and organisation of the research process of innovation projects	D.I.1.1. D.I.1.2. (...) D.I.1.n.
		EI.2. research process implementation	the costs incurred in relation to research completing the existing state of knowledge important for innovation projects; costs of development of scientific idea to the practically useful form; the cost of creation of vision (of a project) of product, process of organisational innovation	D.I.2.1. D.I.2.2. (...) D.I.1.n.
	FII. Research work	EII.1. conceptualisation of re-engineering of innovation implementation conditions	the costs of setting the scope and method of reengineering of corporate conditions to the form suitable for the introduction of innovation solutions; the costs of technical and business documentation for the future phase of business application of innovation	D.II.1.1. D.II.1.2. (...) D.II.1.n.
		EII.2. implementation of re-engineering of innovation implementation conditions	the costs of work on the transition from the research phase to operational phase of the project; costs of launching the reengineering of conditions, e.g. the preparation of manufacturing space, retooling machines and equipment, reorganisation of work and staff training	D.II.2.1. D.II.2.2. (...) Dz.II.2.n.
	FIII. Operational activity with application of innovation	EIII.1. phase of business use of innovation	the costs incurred in relation to the newly manufactured product or commercial application of a new technological process or a new organisational solution	D.III.1.1. D.III.1.2. (...) D.III.1.n.
		EIII.2. innovation effectiveness monitoring during its business life rime	the costs of new solutions with regard to monitoring of innovation undertaking cost effectiveness during the whole period of "innovation effect" and controlling in the same scope.	D.III.2.1. D.III.2.2. (...) D.III.2.n.

Source: authors' own material.

Generic cost drivers in the process of innovation appear in the activities conducted at every stage of every phase of the innovation process. The drivers are identified as a stage or phase of innovation process are exclusively synergic aggregates of generic drivers. The presented concept of the structure of innovation undertaking cost drivers (implemented in the process of innovation) is a visualisation of the cost object, i.e. the innovation process and is a starting point for the cost management related to this process.

Re. 2)

Both on the plane *ex ante* and *ex post* it is important to determine the model of allocation and cost calculation, thanks to which it will be possible to subordinate the cost (*ex ante* and *ex post*) to the activities isolated in the innovation process. The conception to be seriously considered here is the time driven activity based costing (TD-ABC), which may be relatively easily introduced into the area of cost management. It is possible to: (1) identify detailed activities making use of the presented visualisation of the innovation process (see Table 1 for example D.II.2.n) and (2) effect cost allocations applying an understandable cost allocation key, which is a man-hour in the TD-ABC conception. Considering the issue of a cost model

appropriate for application with regard to the innovation process it also has to be decided whether the activities in the innovation process will be allocated with costs indirect for these activities, i.e. costs of other activities not occurring in the innovation process but the ones whose implementation determines the corporate potential to undertake the innovation process. In this place, taking into account the degree of complexity of cost calculations, the cost of conducting them as well as a doubtful information management value of the result of cost calculation, it is suggested that full-costing conception should be rejected and the **conception of activity costs directly connected with the innovation process**, i.e. direct-activity-costing should be applied instead.

Re. 3)

Innovation cost management requires, like cost management in other areas, the information not only about the innovation costs planned but also those incurred. Furthermore, this kind of management should be a permanent process with regard to all the detailed activities isolated within the innovation process. This means that, with regard to every individual activity, it is indispensable to:
1. classify, register and calculate the costs of activity,
2. report the costs incurred,
3. determine cost creating factors with no value added to the activity,
4. introduce reengineering focused on the elimination from the activity of the factors with no value added to it,
5. control the cost effectiveness management of the activity

The classification, registration and calculation of costs requires an appropriate structure of codes in the company allowing for the easy identification of the incurred costs and associating them with the place they come from, which in the case of innovation processes are the activities isolated in it. These codes are also useful in cost aggregate creation including cost values of, for example, a selected group of activities. The inclusion in the account books of the changes resulting from the application of TD-ABC as well as related detailed solutions will require special instructions and staff training but the advantage from the possession of cost information dedicated to the innovation process cannot be disputed. These costs abundant in extensive detailed classification obtained due to the accurate definition of the cost object and its internal activity classification, create a well-developed information base for cost controlling, which may use different models of causal analysis of deviations as well as the analysis of operation quality and as a consequence the whole process.

Re. 4)

Detailed attention should be paid to the information structure of the report on the innovation process costs. This report in indispensable for the cost controlling of this process.
Two managerially useful conceptions of the report structure may be offered. The first one is presented in Table 2.

Cost pool codes			Activity	Costs ex ante t=1 (1)	Costs ex post t=1 (2)	Deviations t = 1 (2)-(1) (3)	Costs ex post t = -1 (4)	Change in % (2)-(4)/(4) (5)
FI	E1	D.I.1.1.	Analysis of needs …	x	x	x	x	%
		D.I.1.2.	Diagnosis of possibilities …	x	x	x	x	%
		(…)	Research visualisation …	x	x	x	x	%
		D.I.1.n.						
			Total	x	x	x	x	%
	E2	D.I.2.1.	Studying problem …	x	x	x	x	%
		D.I.2.2.	Simulating and modelling …	x	x	x	x	%
		(…)	Experimenting….	x	x	x	x	%
		Dz. I.1.n.						
			Total	x	x	x	x	%
			Total	x	x	x	x	%
FII	E1	D.II.1.1.	Reingeneering design…	x	x	x	x	%
		D.II.1.2.	Forecasting and scheduling…	x	x	x	x	%
		(…)	Documenting …	x	x	x	x	%
		D.II.1.n.						
			Total	x	x	x	x	%
	E2	D.II.2.1.	Restructuring…	x	x	x	x	%
		D.II.2.2.	Equipment…	x	x	x	x	%
		(…)	Training …	x	x	x	x	%
		Dz.II.2.n.						
Total			Total	x	x	x	x	%
			Total	x	x	x	x	%
FIII	E1	D.III.1.1.	Manufacturing …	x	x	x	x	%
		D.III.1.2.	Application…	x	x	x	x	%
		(…)	Making use…	x	x	x	x	%
		D.III.1.n.						
			Total	x	x	x	x	%
	E2	D.III.2.1.	Reporting…	x	x	x	x	%
		D.III.2.2.	Analysing…	x	x	x	x	%
		(…)	Intervening….	x	x	x	x	%
		D.III.2.n.						
			Total	x	x	x	x	%
			Total	x	x	x	x	%

t = 1 – current period
t = -1 – analogous former period

Source: authors' own material.

new knowledge will be acquired. If it feasible, there is a question when and what it will include and whether it will be useful for the company. In every phase there is "uncertainty" specific to a given phase. In the innovation process management in the risk conditions, in all the phases there is a group of the same risk factors which appear in every phase. It is determined by the financial possibilities of activity implementation connected with the innovation undertaking in a given phase, the activity technical feasibility and the creative competence (creativity) of the staff conducting a given activity.

Re. 5)

Setting the method of monitoring the innovation undertaking cost effectiveness during the whole period of the "innovation effect" is the core of assessment of advantages resulting from the innovation process. It seems that an auxiliary indicator may be the formula based on the scrutiny on the dynamics of EVA (Economic Value Added) value set for the third phase of the innovation process at a given moment of analysis in connection with the sum of costs

value calculated *ex post* for the completed phases (1 and 2) of the innovation process and the accruing cost value of the third phase. The scrutiny should follow during the whole period of economic life of the third phase of the innovation process.
The conception of this authors' self-designed formula may be presented in the following way:

$$EI = EVA_{3rd\ phase} / \sum_{i=I}^{II} Cost_{phase\ i} + \sum_{t=1}^{n} Cost_{phase\ t}$$

where:
EI – innovation process effectiveness ratio
i – the 1st and 2nd phases completed, isolated in the cost object – innovation process
t – period of implementation of the 3rd phase, isolated in the cost object – innovation process

INNOVATION MANAGEMENT IN THE RISK CONDITIONS

The implementation of the assumptions and goals formulated earlier and connected with the use of human resources and material means poses, for the entity undertaking this sort of tasks, numerous problems related to decision making and activities which make up the process of management. It is worth noting that the decisions and activities in the management process are related to risk, which is an inherent quality of any activity. Hence, there is a term in the English language: Risk Management, which can be interpreted as management in the risk conditions. Implementing five basic functions of the management process (planning, organisation, chain of command, coordination and control), a business entity is exposed to the implementation of risk, both pure and speculative. The risk management procedure consists in working out and using instruments which would raise the effectiveness of the management process with regard to the formulated assumptions and goals. In the majority of considerations we are confined to the pejorative understanding of risk, i.e. we identify the implementation of risk with a loss, which does not fully correspond to the situation of entities interested in business activity. The innovation activity risk whose implementation may bring considerable profits may be a typical example. The innovation process requires support. The companies which implement innovations need support due to a special kind of activity connected with entering new unexplored areas and uncertainty related to it. The innovation process should be properly managed from the stage of planning to implementation to launching. We can see an

important role of risk management and insurance as a method of minimisation of the effects of implementation of a given risk. Through the minimisation of effects of undertaken activities (risk related to it), companies may be more willing to undertake innovation activities. There is an important question to be asked whether the implementation of risk causes an impulse to innovation activity or on the contrary the innovation activity causes a higher exposure to the implementation of a given risk. In this part of the article we will present the research results concerning the development of the insurance sector in Poland. These results constitute the basis for an attempt to answer the question: Does the insurance sector through an appropriate offer and other behaviours which may be perceived as elements of the risk management process support the development of corporate innovativeness or is it

rather passive focusing on risks already diagnosed (fire, flood, theft or accident). Due to quantitative limitations, the article presents only the most important research results and conclusions resulting from them.

3.1. Insurance sector – results of analysis

Methodology used

In this study two groups of measures are used: measuring the distance and measuring similarity. The measure μ describing the degree of similarity between dimension structures of the two objects is defined with the following equation:

$$\mu_{i,p} = \frac{z_i \circ z_p}{|z_i||z_p|}$$

Where: $z_i \circ z_p$ denotes the scalar multiple of vectors zi and zp containing all dimensions of the particular objects and the length of the vectors. This means that the value of the μ is between -1 and 1 as the scalar multiple is a cosine of the angle between the vectors.
The measure of similarity of objects' dimensions d*(i,p) is defined by the following equation:

$$d^*(i,p) = 1 - \frac{1}{2\sqrt{kn}} * d(i,p)$$

$$0 \le d^*(i,p) \le 1$$

Where: k denotes the number of objects and n, the number of dimensions, is a normalized version of the differentiation of objects' dimensions d(i,p).

$$d(i,p) = \sqrt{\left(\sum_{i=1}^{k} (z_{i,i} - z_{i,p})^2\right.}$$

Where: dip denotes the distance between the objects i and p and zijzpj the values of dimension j of object i and p respectively.
The research was conducted by means of the multidimensional statistical analysis. Because of the comparative procedures (comparison of the same entity in different periods) taxonomic 8

procedures were used. The comparison was made with regard to the development of the insurance sector consisting of four subsectors: *catastrophe insurance, life insurance, health insurance and financial insurance.* In each subsector there were three groups of diagnostic features. Before the beginning of research the database was created including the implementation of selected diagnostic features in the years 1991-2010 (the features are presented in Enclosure 1). Eventually, the number of features was decided after the analysis of correlations between them; whereas the length of observation series was determined by means of availability of implementations of features from all the groups.

The database includes the implementations of diagnostic features for the analysed period. Initially it was planned to conduct the analysis of the years 1991 – 2010. However, the gathered data allowed for the full comparisons for the period 2000 -2010 (due to the availability of the feature implementations from all the groups). The period of the last 10 years may be regarded as interesting from the perspective of economic changes. In this time there was a period of good economic situation as well as a slowdown (the 2007 crisis).

The construction of the database was based on the information from reliable statistical sources published by the following institutions: the National Bank of Poland, the Central Statistical Office, the Financial Supervision Authority, IMGW and the Ministry of Health.

The analysis of the obtained correlation coefficients justifies the use of all diagnostic features. We remained with the expert selection, although we discern correlations which as a consequence of the use of statistical methods of selection of diagnostic features would cause the elimination of some features.

Next, the assessment was made of the sector development directions in the selected years of the analysed period. For comparison, the benchmark was set. In our case the benchmark was set in the group of experts based on algorithms presented by well-known statisticians (Z. Hellwig), separately for individual kinds of diagnostic features. In the case of stimulants the benchmark was calculated as a diagnostic feature of maximum value in the analysed period increased by a standard deviation for the whole time series. In the case of destimulants the benchmark value is 0 or minimum value decreased by a standard deviation, depending on which of the two values is higher. For nominants the benchmark value was set as an average value increased by a standard deviation or median depending on the character of the feature and the number of available observations. In order to maintain the clarity of the presentation the radar charts weren used. The chart axes are the analysed subsectors (in the case of sector analysis) or feature group (in the case of subsector analysis). Thus, Subsector 1 stands for catastrophe risk; Subsector 2 for life insurance; Subsector 3 for health insurance and Subsector 4 for financial insurance. The results of calculation for the measure of differentiation of levels d^* and structure similarity μ^* are presented in the charts below respectively.

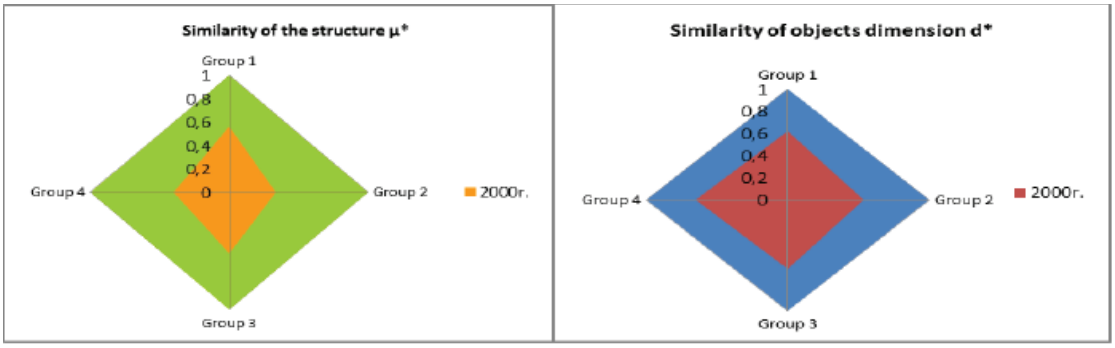


Figure. 1. Similarity of the structure and similarity of objects dimension in 2000 in comparison to reference object. (Reference object is market yellow and blue colour).
Source: author's own materials.

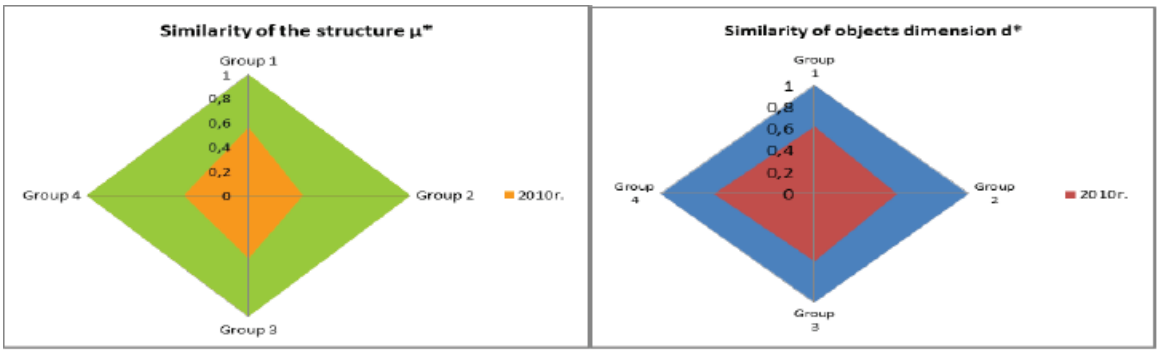


Figure. 2. Similarity of the structure and similarity of objects dimension in 2010 in comparison to reference object. (Reference object is market yellow and blue colour).
Source: authors'own material.

In the analysed period there were important changes in the insurance sector. The presented calculations on the basis of comparison of similarity measures in the years 2000-2010 in the insurance sector indicate a definite improvement in the life insurance subsector in 2005 and the stabilisation since then. As far as the health and financial subsectors are concerned, the period 2000-2010 is characterised by a constant improvement of the structure features (close to the benchmark). In the case of catastrophe insurance the applied measures reflect the occurrence of natural catastrophic phenomena.

The second stage of research makes a comparison of the development insurance subsectors. Like in the case of the comparison of the whole sector at the first stage the correlations between features were examined. Next, the calculation of the structure similarity measure and differentiation of feature levels was conducted. The results are graphically presented in radar graphs in Enclosure 2 to the present article.

Analysing the subsectors it should be underlined that within the subsector of catastrophe insurance, there is a dangerous phenomenon of negligence of preventive actions connected with the implementation of the risk of flood (diagnostic features in group 3 concerned this risk). Besides, it should be pointed to the sensitivity of the applied measures to the weather factors (group1). In the sector of life insurance there was a considerable increase in economic features (group 1). There was a change in the significance of financial and social features in the analysed period. In 2005 group 3, i.e. social feature, approached the benchmark the closest, financial features also became more important. However, already in 2010 the

significance of these groups decreased. In the sector of health insurance there is a perceptible rise in activity of households (group 2) and decline in the significance of the state policy (group 1). The signals of the activeness of the market in this sector are weak. Within the sector of financial insurance the biggest changes occurred in the third group (microeconomic features) and group 2 (operations of insurance companies and banks).

CONCLUSIONS

In many literature titles the problems of risk management are considerably simplified or oversimplified through the inaccurate interpretation of the phrase Risk Management. In numerous works the dominating perception of this notion is ”risk management” in the literal meaning. As a result complex problems derived from the disciplines of the management Science and the Risk Theory have been grossly limited, instead due to the needs of the financial market sectors, the problems of risk are being consistently developed. The management instruments so important for the effectiveness of the Risk Management procedure have been pushed into the background. This complicated procedure requires a 10

comprehensive approach combining the problems of risk with efficiency and effectiveness of the instruments applied in the course of implementation of the aforementioned functions of management. Only the joint consideration of the process of risk with distinguishing such categories as: *the subject of risk, risk implementation, probability of risk implementation* or *risk implementation effects*, which occur as the components of the risk process with the management instruments and tools allows for the full comprehension of the idea and goals of this procedure. The main goal of risk management is the improved effectiveness of the entity’s operation through an appropriate reaction to the risk connected the entity’s activity. The example to be quoted may be innovation activities, where the management of knowledge, cost and the whole process in the risk conditions should be coherent and mutually complementary. Innovative companies apart from the application of knowledge as well as an appropriate analysis and budgeting (allocation) of costs within algorithms of behaviour compliant with the risk procedure management should be supported by the insurance sector. However, the examination of the sector shows that in Poland in the analysed period the insurance market was not innovative and it did not create innovation supporting services (and it is where the insurance risk appears due to the financial aspects of innovation). Simultaneously, insurance did not encourage investment in research and development. An essential function of insurance as a specific financial market sector is to encourage economic growth through the redistribution of gathered capitals. Insurance as one of the basic financial tools of the Risk Management procedure should play an important role in the process of development of innovation and as a consequence the economic growth.

BIBLIOGRAPHY:

1. Bac. M., *Zarządzanie ryzykiem katastroficznym w nieruchomościach. Rozwiązania ubezpieczeniowe w Polsce i na świecie*, wyd: „DOM ORGANIZATORA” Toruń 2009 r.,
2. Balicka D., *Umowa ubezpieczenia zdrowotnego*, materiały z konferencji *Umowa ubezpieczenia zdrowotnego*, Serock 24-25.02.2009
3. Biulletin of the Commission on Insurance Terminology of the American Risk and Insurance Association, Vol. 2, No. 1, marzec 1966.

4. Boniecki M, Grabowski R., *Parametry charakteryzujące innowacje*, [w:] A. Karmańska (red.) *Zarządzanie kosztami jakości, logistyki, innowacji, ochrony środowiska*, Difin, Warszawa 2007, s. 120-129
5. Czapiński J., Panek T. (red.) *Diagnoza społeczna 2009. Warunki i jakość życia Polaków*, Warszawa: Rada Monitoringu społecznego, 2009.
6. Doan O., *Historyczne formy ubezpieczeń życiowych*, [w] O. Doan (red.), Ubezpieczenia życiowe, Poltext, Warszawa1996,
7. Fal D., *Ubezpieczenia zdrowotne - miejsce i rola w opiece zdrowotnej w Polsce. Trendy, prognozy, przyszłość,* materiały z VI Forum Ubezpieczeń, 24-26.09.2008
8. Geppert. E., *Problem ryzyk wielkich i katastrofalnych*, „Wiadomości Ubezpieczeniowe", 1971 Nr1
9. Grovas S.V.P., A *Credit Risk Model To Develop The Credit Insurance Market*, "Journal of Business & Economics Research" July 2008, Vol. 6, No. 7, s. 139-146.
10. Śliwiński A., *Ryzyko ubezpieczeniowe. Taryfy – Budowa i optymalizacja*, Poltext, Warszawa 2002,
11. Wanat-Połeć E. (red) *Metodologia analizy finansowej zakładów ubezpieczeń*, Departament Analiz Systemu ubezpieczeniowego, PUNU, Warszawa,
12. Wierzbicka E. (red.), *Ubezpieczenia osobowe*, Wolters Kluwer, Warszawa 2008
13. Willett A.H, *The Economic Theory of Risk and Insurance*, The University of Pensylvania Press, Philadelphia wydanie z 1951 r.
14. Vaughan E. F., Voughan T., Fundamentals of Risk and Insurance, Eight Edition, John Wiley & Sons,
15. Zietz E., *An Examination of the Demand for Life Insurance*, „Risk Management and Insurance Review", 2003, Vol 6, No 2,

Attachment 1

Diagnostic features

#	Mark	Feature	Kind of influence
1	X1	Average yearly rainfall level	Positive
2	X2	Maximum rainfall level	Positive
3	X3	Average wind speed - annul	Positive
4	X4	Medium temperature	Neutral
5	X5	Absolut minimum temperature	Neutral
6	X6	Absolute maximum temperature	Neutral
7	X7	Flood shafts long	Negative
8	X8	Flood area protected	Negative
9	X9	Capacity of flood shafts	Negative
10	Z1	Changes of GDP	Positive
11	Z2	Financial development	Positive
12	Z3	WIG index	Positive
13	Z4	Average monthly salary	Positive
14	Z5	Gross written premium	Neutral
15	Z6	Profitability of technical accounts	Positive
16	Z7	Return on equity	Positive
17	Z8	Claims ratio	Negative
18	Z9	Changes of structure of gross written premium	Positive
19	Z10	Education level	Positive
20	Z11	Dependency ratio	Positive
21	Y1	State of health care	Positive
22	Y2	Share of state spending in total healthcare spending	Negative
23	Y3	State policy ion terms of health care	Negative
24	Y4	Share of health care spending in budget of households	Positive
25	Y5	Change of number of private health care costumers	Positive
26	Y6	Monthly average salary	Positive
27	Y7	Households health spending	Positive
28	Y8	Change of health insurance gross written premium	Positive
29	Y9	Healthcare insurance offer	Positive
30	Y10	Price of healthcare insurance polices	Positive
31	F1	Changes of GDP	Positive
32	F2	Changes of GDP - trade	Positive
33	F3	Changes of GDP - industry	Positive
34	F4	Changes of GDP - construction	Positive
35	F5	Changes of domestic investment	Positive
36	F6	Changes of FDI	Positive
37	F7	PLN/Euro – exchange rate	Neutral
38	F8	PLN/USD – exchange rate	Neutral
39	F9	Export [mln PLN]	Positive
40	F10	Gross written premium in financial insurance	Positive
41	F11	Level of claims in financial insurance	Negative
42	F12	Number of polices of financial insurance	Positive
43	F13	Insurance premium	Neutral
44	F14	Capacity of insurance guarantees market	Negative
45	F15	Level of expired debts	Negative
46	F16	Number of bankrupt companies	Negative

* Feature marked by different colors were chosen for the analysis of different insurance sector. $X_1 - X_9$ – describescatastroficinsurance, $Z_1 - Z_{11}$ – Life insurance, $Y_1 - Y_{10}$ – Health insurance, $F_1 - F_{16}$ – Financial insurance

Attachment 2

Catastrophic insurance

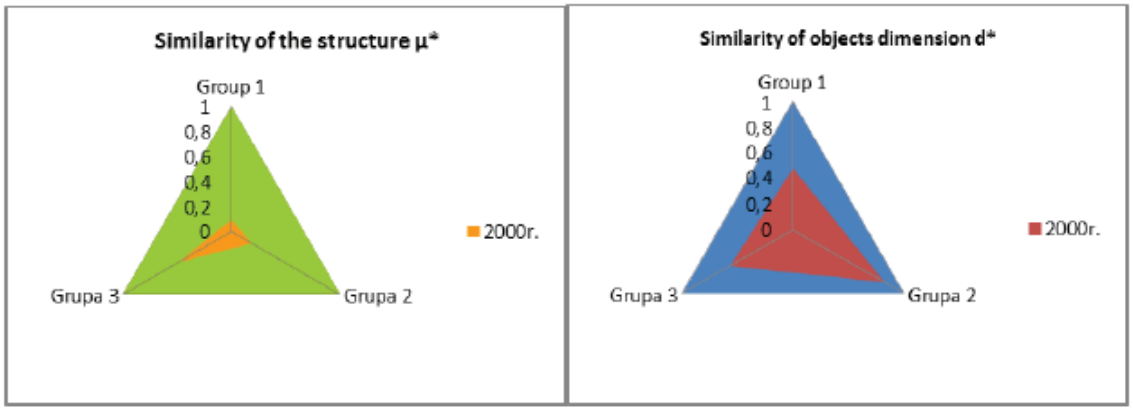


Figure.1. Similarity of the structure and similarity of objects dimension in 2000 in comparison to reference object. (Reference object is market yellow and blue colour).

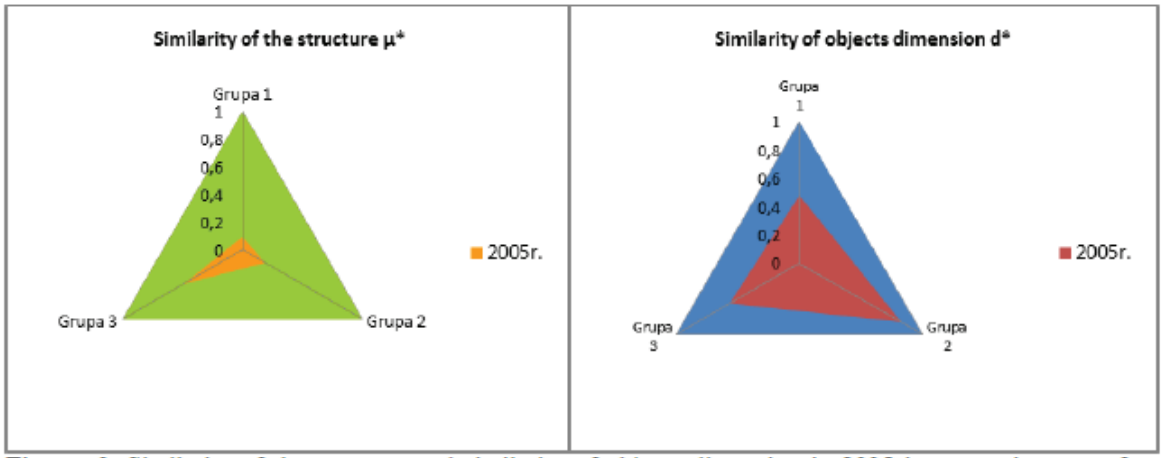


Figure. 2. Similarity of the structure and similarity of objects dimension in 2005 in comparison to reference object. (Reference object is market yellow and blue colour).

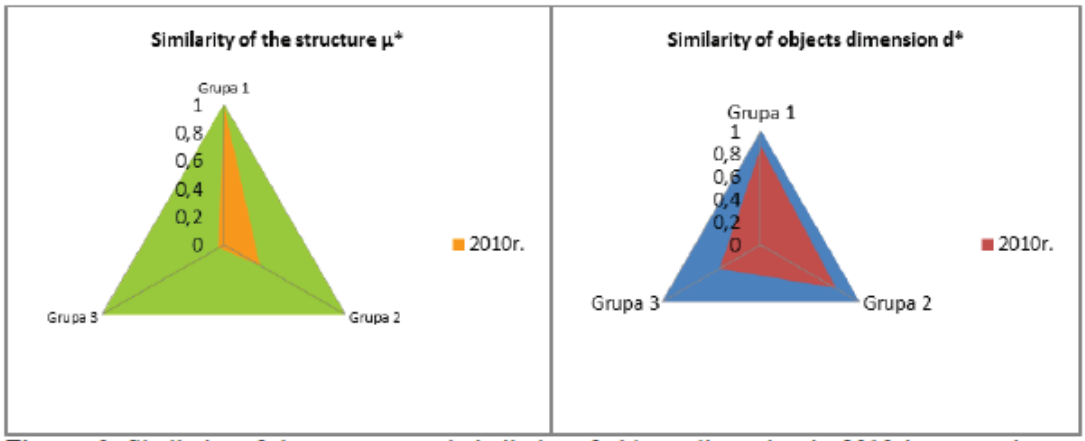


Figure. 3. Similarity of the structure and similarity of objects dimension in 2010 in comparison to reference object. (Reference object is market yellow and blue colour).

Life Insurance

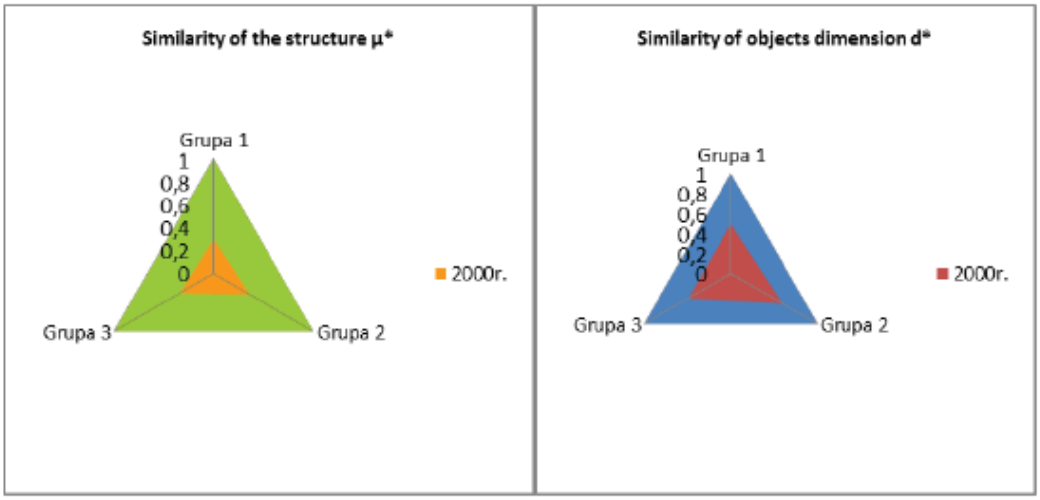


Figure. 1a. Similarity of the structure and similarity of objects dimension in 2000 in comparison to reference object. (Reference object is market yellow and blue colour).

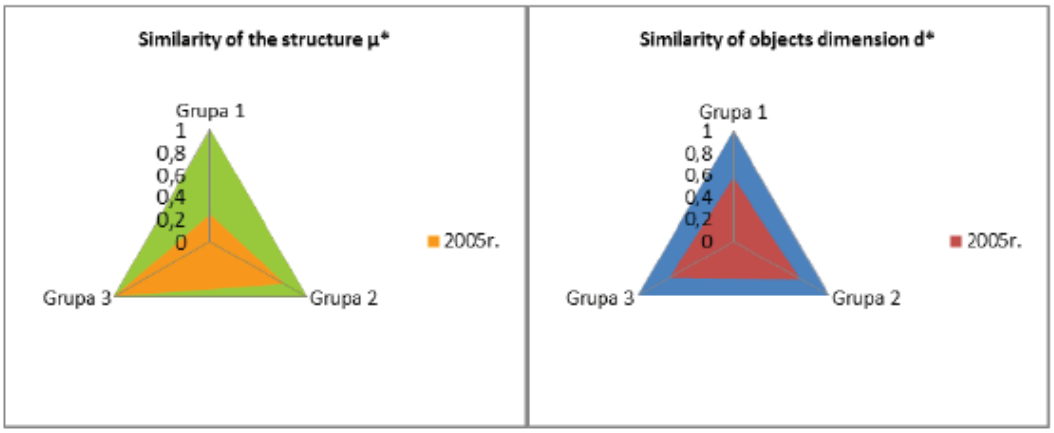


Figure. 2a. Similarity of the structure and similarity of objects dimension in 2005 in comparison to reference object. (Reference object is market yellow and blue colour).

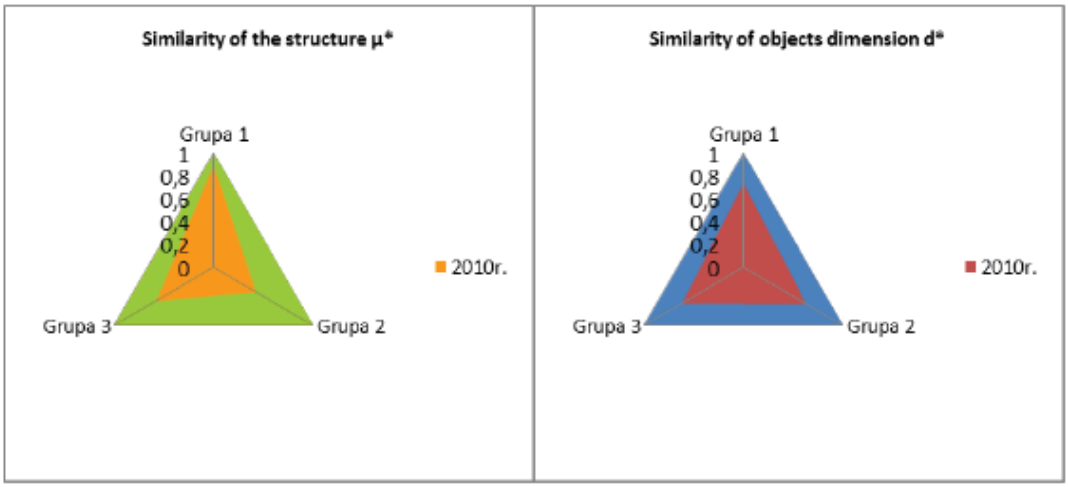


Figure. 3a. Similarity of the structure and similarity of objects dimension in 2010 in comparison to reference object. (Reference object is market yellow and blue colour).

Health Insurance

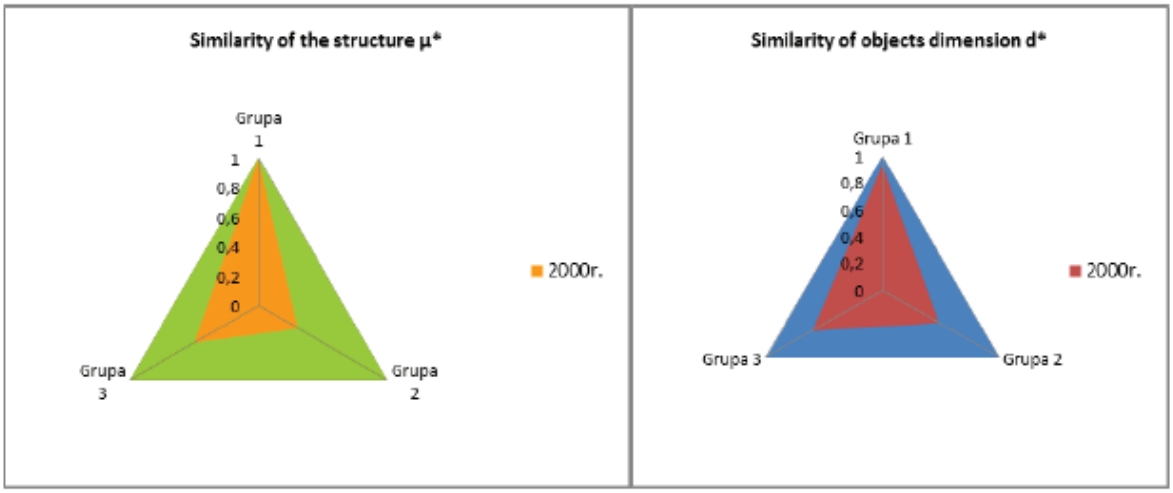


Figure. 1b. Similarity of the structure and similarity of objects dimension in 2000 in comparison to reference object. (Reference object is market yellow and blue colour).

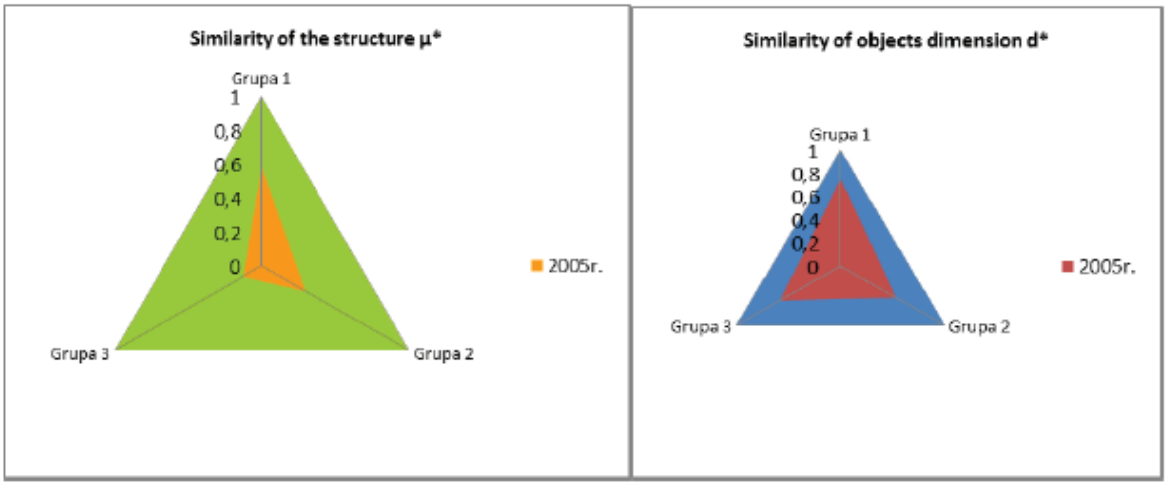


Figure. 2b. Similarity of the structure and similarity of objects dimension in 2005 in comparison to reference object. (Reference object is market yellow and blue colour).

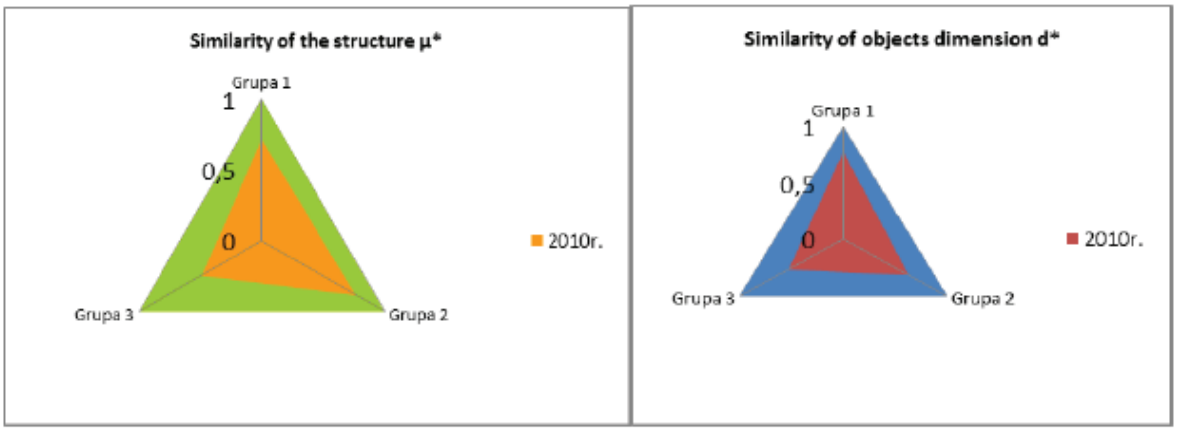


Figure. 3c. Similarity of the structure and similarity of objects dimension in 2010 in comparison to reference object. (Reference object is market yellow and blue colour).

Financial Insurance

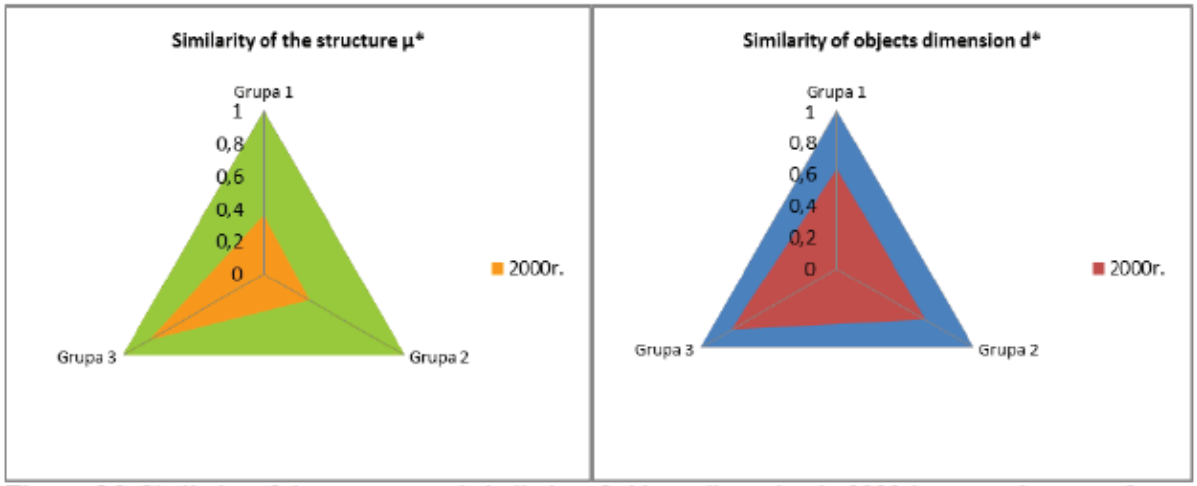


Figure. 1d. Similarity of the structure and similarity of objects dimension in 2000 in comparison to reference object. (Reference object is market yellow and blue colour).

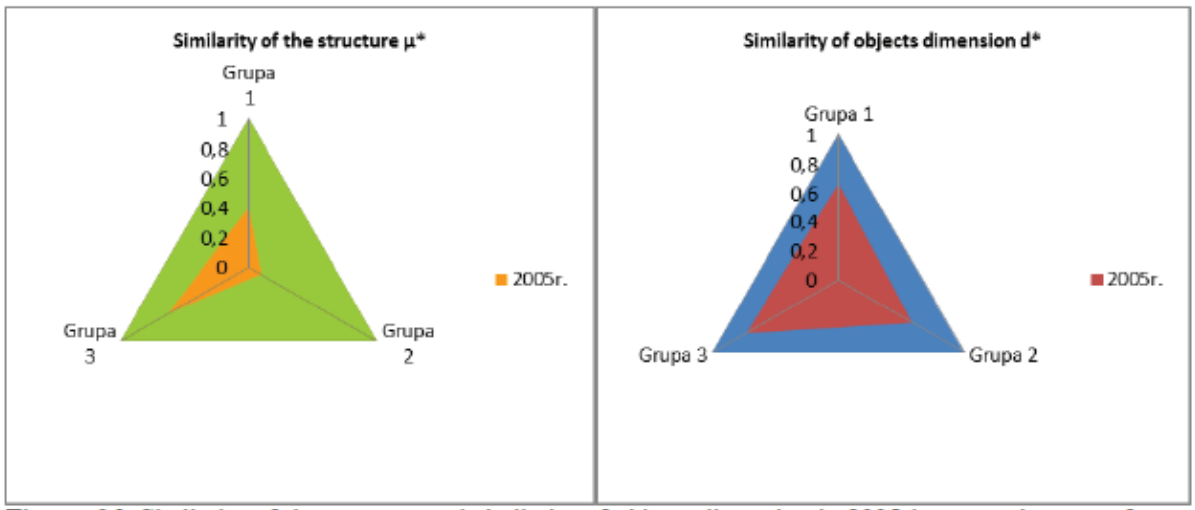


Figure. 2d. Similarity of the structure and similarity of objects dimension in 2005 in comparison to reference object. (Reference object is market yellow and blue colour).

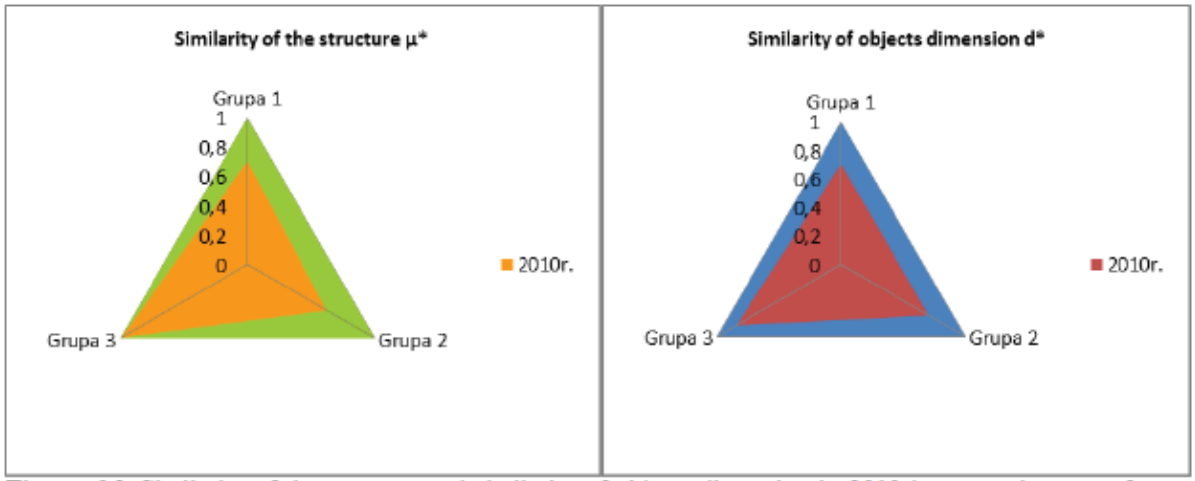


Figure. 3d. Similarity of the structure and similarity of objects dimension in 2010 in comparison to reference object. (Reference object is market yellow and blue colour).

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

FORMULATION OF MARKETING INFORMATION AND COMMUNICATION STRATEGIES IN TAIWAN TOURISM INDUSTRY

Tzong-Ru(Jiun-Shen) Lee, National Chung Hsing University, Taiwan
Email: trlee@dragon.nchu.edu.tw

Yu-Hsuan Kuo, National Chung Hsing University, Taiwan
Email: yumi-nature1123@hotmail.com.tw

Per Hilletofth, Jönköping University, Sweden
Email: per.hilletofth@jth.hj.se

ABSTRACT

Purpose: *The purpose of this research is to formulate marketing information and communication (ICT) strategies for Taiwan tourism industry.*
Design/methodology/approach: *This research uses a literature review to identify problems and solutions of Taiwan's tourism industry. One of the identified problems is used as an example to formulate marketing ICT strategies.*
Findings: *This research has identified twenty-five main problems and forty-eight solutions of Taiwan's tourism industry and formulated marketing ICT strategies for one of the identified problems.*
Research limitations/implications: *The subsequent research can apply other research method to improve the reliability and validity.*
Practical implications: *The application of marketing ICT strategies can be used in other country's tourism industry and be adapted to other industries as well.*
Originality/value: *This research clarifies the problems of Taiwan's tourism industry and applies marketing ICT strategies in Taiwan tourism industry.*

INTRODUCTION

The tourism industry is highly valued and generally acknowledged as a tertiary industry. One reason for this is that the traveling and staying of tourists outside their usual environment may bring tourism revenue. In addition, the tourism industry involves many other industries such as hotels, catering, aviation, transportation, and so forth. This implies that once the tourism industry prospers, it may push other industries forward as well. It will not only bring tourism revenue but also increase consumption and employment. As a consequence, tourism makes vital contribution to the overall economy.

Taiwan (or Republic of China, ROC) is an island country; its territory is not large but includes abundant nature landscapes and distinctive artificial scenery. For instance, Taroko National Park is well known for its majestic canyon and precipice and city of Tainan preserves lots of historical sites. Taiwan possesses rich natural resources that can be used to expand tourism industry. Moreover, tourism industry was listed as one of the Taiwan's six emerging industries, which proves that tourism is becoming more and more important.

Many countries have started to give more attention to the tourism industry. The United Nations World Tourism Organization (UNWTO) claims that the tourism industry has become a vital source of earning foreign exchange. In Taiwan, approximately 8% of foreign exchange is derived from tourism industry and it accounts for more than 15% of Gross Domestic Product (GDP). According to the statistics of the Tourism Bureau of ROC, foreign exchange earnings in Taiwan from tourism were up to 260 billion NT$. UNWTO also predicts that the tourist attendance will increase to 1,602 million in the world in 2020. As a result, the tourism industry plays an important role to a country and the whole world.

According to the World Tourism Barometer, the tourist attendance was increasing during 2011 and the Asia's growth rate of international tourist was up to 14.1% compared to 2010. Among the Asia countries, Taiwan's tourist attendance was up to 29% especially. Recently, the mainland tourists are increasing. One reason for this is that the government of ROC has promoted tourism for several years and another is that the government has signed the Specific Arrangements Concerning Cross-Strait Tourism in 2008. Taiwan's visitor arrivals had come to 6 million in 2011 consequently (Table 1).

Table 1: Taiwan's Visitor Arrivals 2006-2011

Year	Total		
	No of Visitors	Growth Rate %	Index 1991 = 100
2006	3,519,827	4.19	189.80
2007	3,716,063	5.58	200.38
2008	3,845,187	3.47	207.34
2009	4,395,004	14.30	236.99
2010	5,567,277	26.67	300.20
2011	6,087,484	9.34	328.25

Source: Tourism Bureau of Republic of China (R

The sales volume of smartphones was 420 million and that of tablet personal computers was 41 million in 2011. The most important fact is that the total sales volume of these two products was more than personal computers, proving that the tendency of mobile computing is coming. Taiwan has endeavored to develop the information and communications technology (ICT) industry for several years; therefore, it has solid foundation of the infrastructure and rich experiences in manufacturing and management. The government of ROC also kept investing in ICT research, as well as encouraged creation and invention. For the sake of expecting they could lead the development of related industries and bring the knowledge spillovers effect for other industries to increase work efficiency, promote productivity and raise value added, and spur the economic growth.

Although Taiwan has put a lot of efforts on the tourism industry for many years and the visitor arrivals are increasing stably, there still is room for improvement. As the ICT industry has become more and more important, the tourist attendance has increased rapidly, and ROC has allowed travel in Taiwan, the number of tourists will probably increase day by day, and it certainly will change the state of Taiwan's tourism industry. This research investigates how the use of ICT can improve the Taiwan's tourism industry. The aim is to formulate marketing ICT strategies for Taiwan tourism industry. In essence, main problems and solutions of Taiwan's tourism industry is identified and based on these some marketing ICT strategies are formulated.

The remainder of this paper is structured as follows: To begin with the research approach is described shortly in Section 2. Thereafter, a literature review on main problems and solutions of Taiwan's tourism industry is provided in Section 3. After that, we use one of the identified problems as an example (some of Taiwan's tourism corporates and shopping areas lack of marketing ability) to formulate marketing ICT strategies in Section 4. Finally the research is concluded in Section 5.

RESEARCH APPRAOCH

This research uses a literature review to identify problems and solutions of Taiwan's tourism industry. Articles that discuss main problems, and possible solutions to these problems, have been collected within five specialized business fields: (1) product management, (2) marketing management, (3) human resources management, (4) research and development management, and (5) financial management. Since the identified problems and solutions were too many and diverse from each other, they were classified into different groups. One of the identified problem groups (some of Taiwan's tourism corporates and shopping areas lack of marketing ability) is used as an example to formulate marketing ICT strategies for Taiwan tourism industry. We expect the marketing ICT strategies will attract more foreign tourists to Taiwan and become a case study for the development of other countries' tourism industries.

LITERATURE REVIEW

Much literature discusses problems and solutions in Taiwan's tourism industry. Our literature review revealed twenty-five main problems of Taiwan's tourism industry (Table 2). Since the identified problems (No. 1-25) were quite many and diverse from each other, they were classified into different problem groups (Table 3). For example, problem No. 8, 14, 15, and 23 in Table 2 are all descriptions of the problem "Service quality in some Taiwan's tourist spots is not satisfying due to employee lack of capability". We therefore categorize them into the same group (A) in Table 3.

Table 2: Main Problems of Taiwan's Tourism Industry

Authors	No	Problems
Deng et al. (2007)	1.	There were few proper channels for tourists to communicate with the hotel proprietors.
	2.	The ways that hotel proprietors deal with the customer relationship problems are usually inadequate and their ability of external communication is insufficient.
Chen (2005)	3.	Although there are many well-known tourist spots in Taiwan, the level of tour packages are not deep and wide enough; leading to low value added.
Hsieh et al. (2008)	4.	The communication and propagation ability of B&B owners is insufficient, and they also lack of effective promotions.
	5.	The expenditure of most Taiwan's tourist spots is too high.
Lee et al. (2008)	6.	The channel strategies of Taiwan's tourism are deficient.
	7.	Taiwan's tourist spots and shopping areas are short of impressive integrating brand elements and corporate Images.
Yeh and Wang (2001)	8.	Service quality of some tourist spots shopping areas in Taiwan couldn't satisfy their customers.
Dai (2008)	9.	Most of Taiwan's tourism corporates are medium and small-size enterprises, and that's the reason why it's usually uneasy for them to get financing loans.
	10.	Financial transparency of medium and small-size tourism corporates is defective and some of them even lack of accounting system.
Hwang and	11.	The average wages of Taiwan's tourism are too low.

Authors	No	Problems
Chen (2009)	12.	The job satisfaction of staff is low, but the employee turnover rate is high.
Lee (2005)	13.	Most the meals in the tourist spots or shopping areas are lack of distinguishing features and creation.
	14.	The on meal speed in the tourist spots or shopping areas is slow.
	15.	The meals and dinning environments in some of the travel sites are not that hygienic.
Chen and Wu (2009)	16.	The contents of package tours are indistinctive.
Otto and Ritchie (1996)	17.	The positions of most Taiwan's travel sites are ambiguous.
Chih et al. (2006)	18.	The duties of employees are unclear.
	19.	Some of the tourism corporates don't provide equitable promotion methods and employee evaluation system.
	20.	The standards of recruiting are various.
Liu and Chen (2011)	21.	Most of the mini tourism corporates can't keep their customers staying longer and lack of local tourism industry planning to promote economic growth.
Lai et al. (2011)	22.	Some of the Taiwan's traveling sites are too remote to reach.
	23.	The guides in the tourist spots are insufficient.
	24.	Most of the tourism corporates were unclear towards the policy and government grants.
Denhning et al. (2005)	25.	Most of Taiwan's tourist spots had low prestige on the internet.

Table 3: Problem Groups of Taiwan's Tourism Industry

Problems	No	Problem Group
8、14、15、23	A.	Service quality in some Taiwan's tourist spots is not satisfying due to the employees lack of capability.
9、10	B.	Financial infrastructure in some medium and small-size tourism corporates is incomplete.
11、12、18、19、20	C.	Personnel management and staff motivation are defective in some tourism corporates.
1、2、5	D.	Inefficiency in communication with customers.
3、4、6、25	E.	Some of Taiwan's tourism corporates and shopping areas lack of marketing ability.
13、16	F.	Meals and leisure activities in some tourists spots are insufficient and without innovation.
7、17	G.	There are barely any brand elements and proper positions in most of Taiwan's tourism corporates
21、24	H.	Taiwan's tourism industry lacks of integrated planning to create revenue.
22	I.	Some of the Taiwan's traveling sites are too remote to reach.

Based on the generated problem groups, forty-eight corresponding solutions were identified in the literature review (Table 4). In Table 4, we can see the different problem groups and the corresponding solutions. The solutions not identified from literature review were deduced by analogy by the authors.

Table 4: Solutions To Main Problems of Taiwan's Tourism

Problem Group	No	Solutions	Authors
A. Service quality in some Taiwan's tourist spots is not satisfying due to the employees lack of capability.	A1.	Select outstanding students from department of tourism, tourism experts, and the employed of relative industries to well-known foreign hotels or institutes to pursue further education every year.	Chen and Chen (2008)
	A2.	Provide education and training for attendants and apply standard operating procedure (SOP) to manage them.	
	A3.	Set up internal tourism staff training, for instance subsidizing to run senior leader programs of tourism, inviting experts to participate in seminars.	
	A4.	Improve the environmental sanitation.	Lee (2005)
	A5.	Set up standard purchase and produce systems to make sure every segment is checked on.	
B. Financial infrastructure in some medium and small-size tourism corporates is incomplete.	B1.	Establish accounting system.	Dai (2008)
	B2.	Make use of government resource.	
C. Personnel management and staff motivation are defective in some tourism corporates.	C1.	Concerned about employees.	Hwang and Chen (2009)
	C2.	Design inner compliant channels.	
	C3.	Arrange employees' insurance and retirement systems.	
	C4.	Create particular and harmonious corporate culture.	Lee (2010)
	C5.	Establish employee motivational system based on their achievement.	
	C6.	Build up management and employee evaluation system.	
	C7.	Design main tasks and responsibilities of gross root employees.	Chih et al. (2006)
	C8.	Provide professional training for employees.	
D. Inefficiency in communication with customers.	D1.	Establish member data system.	Deng et al. (2007)
	D2.	Take account of relationship marketing.	
	D3.	Establish the interaction with customers via social network.	
	D4.	The B&B proprietors should show consideration actively for their customers, even open their hearts to each other.	Lu et al. (2008)
E. Some of Taiwan's tourism corporates and shopping areas lack of marketing ability.	E1.	Increase promotive tour packages.	Chen (2005)
	E2.	Take advantage of internet marketing, public reports, and travel magazines to raise prestige.	Huang (2006)
	E3.	Apply strategic alliance to different business fields or the same trades.	
	E4.	Adopt search engine optimization (SEO)	ComScore (2009)
	E5.	Take advantage of Internet marketing and try to make the information on websites abundant and orderly.	Lee et al. (2008)
	E6.	By sharing the articles on Blogs to create loyal customers.	
	E7.	Adopt location based service (LBS).	
	E8.	Enrich customers' cultural knowledge with local impression, environment, and resources.	Benz and Fürst (2002)
	E9.	Develop products with stories to make customers touched.	Liu et al. (2011)
	E10.	In compliance with area feature to invite international competitions or exhibitions to Taiwan hereby let more people acquainted with Taiwan.	

Problem Group	No	Solutions	Authors
F. Meals and leisure activities in some tourists spots are insufficient and without innovation.	F1.	Combine with local products to create diversity of dishes.	Lee (2005)
	F2.	Design experience activities which combined with local culture, natural landscape, and ecological environment.	Rossman (1989)
	F3.	Apply local and community life culture creatively into your corporate's core ideology.	
	F4.	Apply local cultural features into your corporate culture.	
	F5.	Provide theme activities such as entertainments, education, and virtual reality to enrich customers' life experiences and emotional feelings.	Lin and Huang (2009)
	F6.	Design experience activities for tourists to learn cultural knowledge and experience different life styles.	
	F7.	Provide interactive guidance, narration service, or guidance facilities.	
G. There are barely any brand elements and proper positions in most of Taiwan's tourism corporates	G1.	Establish brands and corporate images.	Lee et al. (2008)
	G2.	Design the environment with the same theme to create obvious atmosphere.	Otto and Ritchie (1996)
	G3.	Design the environment with five senses experience to improve the recognition of brands.	
	G4.	By visual designing to create space harmony.	
	G5.	Adopt knowledge management systems (KMS).	Lai et al. (2011)
H. Taiwan's tourism industry lacks of integrated planning to create revenue.	H1.	Coordinate with government policies to create tourism revenue.	Landry (2000)
	H2.	Enhance the marketing ability to attract more foreign tourists.	Wu (2011)
	H3.	Coordinate with neighboring tourist spots to develop a win-win situation.	Chen et al. (2008)
	H4.	Tie in relative festivals to attract more tourists.	Liu et al. (2011)
	H5.	Establish local integrated marketing platform.	Carayannis and Alexander (2006)
I. Some of the Taiwan's traveling sites are too remote to reach.	I1.	Mark the routes on Google Map.	Lai et al. (2011)
	I2.	Provide shuttle services.	

The literature review shows that there still are lots of challenges in the front of the Taiwan tourism industry (Table 3). Although there are many tourist spots, which are no less amazing than the foreign, lack of integrated planning and undistinguished characteristics of traveling sites, limits the success. The literature review also shows that there are plenty of solutions to the identified problems that should be considered (Table 4). Nevertheless, the state of Taiwan's tourism is different from the past. Taiwan has put a lot of efforts on ICT industry and has a sturdy foundation. In the following, we will focus on the combination of Taiwan's tourism and ICT on the identified problem of "Some of Taiwan's tourism corporates and shopping areas lack of marketing ability" We expect it will make more foreigners know about Taiwan and further attract them to make a tour there.

AN EXAMPLE OF APPLICATION OF ICT

As the ICT is evolving, the ways people live and travel have changed a lot. For example, the Internet age brings more creative business models and marketing skills and even makes social networks become new media. The smart phones also bring us a more convenient life style.

ICT means using technology to reach the telecom communication effect and changes the instrumentality of communication between people through the broadcasting of voice, words and messages. As the matter of fact, we suggest using marketing ICT strategies within the Taiwan tourism industry to solve the identified problem of "Some of Taiwan's tourism corporates and shopping areas lack of marketing ability". In the following, we provide recommendations with regard to three areas: (1) Social network marketing, (2) Location Based Services and (3) Internet marketing channel. This may strengthen the connection with foreign tourists and increase the value added in Taiwan's tourism industry.

Social Network Marketing

We can use social networks to conduct integrated marketing. For instance, making mini short videos to introduce different local images and characteristics to tourists traveling from different countries with different needs. The videos can then be broadcasted through satellite TV or Internet (e.g., Youtube) to create topics and discussions. We want to motivate traveling to Taiwan by using the videos to increase the visibility of Taiwan and change the mindset of foreign tourists. Moreover, tour spots and shops can set up official Facebook pages or use Twitter to create interaction with the potential visitors. For example, creating events for fans that can be shared with friends in order to have a chance to win discount coupons or other prices. This allows the shops or tour spots to make exposure to consumers frequently and to revoke the memory of the consumers to increase sales.

Location Based Services

The tourists can freely use the Radio Frequency Identification (RFID) personal navigation with different language versions to find answers and information and by combining it with QRcodes, it will also increase the involvement of the tourists. QRcodes have been used widely in the daily life and could also be used in the tourism industry on websites or tour spots to inform the tourists in a faster and better way. It is also possible to add information about parking options and public toilets on the QRcode or include QRcode in shopping catalogues to allow tourists to buy souvenirs by phone. The tourism industry can also use instant messages or QRcodes, to send information about discounts once the tourists arrive to a location. This will make the tourist more familiar with the surroundings and hopefully increase their interest to other products and services.

Internet marketing channel

On an Internet based selling platform we can place information about local specific products to increase the valued added and to conduct integrated marketing. For example, the Taobao net or the largest tour news media, the TraNews, is going to launch Malaysia and Taiwan ECMALL website to advertise specific products in Taiwan to different countries. A website is able to introduce the full range of products and service and to provide links to tour spots in Taiwan. In addition, it could give information about shops to make foreign visitors more eager to visit Taiwan. Development of different Apps with food maps and traffic ways in Taiwan would facilitate tourists traveling in Taiwan.

Summary

The use of marketing ICT strategies in the tourism industry in Taiwan is more than the above shown examples. It could reduce the distance to potential consumers by allowing an efficient mean of communication. This allows foreigners to get access to information about Taiwan to improve their interest and willingness to visit Taiwan. In the longer run this will help Taiwan tourism industry to grow.

CONCLUSSION

There are many island countries like Taiwan with abundant nature as well as culture sights. However, the problem is that island countries are difficult to connect to other countries. Thus it is a hard work to develop the tourism industry. Today, with the advancement of ICT it is not that difficult to make foreign visitors aware of Taiwan but to attract them to visit. In our literature review we have identified twenty-five problems and forty-eight solutions. However, the development of tourism industry is more different now than before. The government of ROC has worked hard on the tourism industry in recent years and actively developed the ICT industry. If we use ICT strategies in tourism industry, it may bring us opportunities. We expect it will not only make more foreign visitors come to Taiwan but also upgrade the industry in Taiwan and make Taiwan as a case study in the tourism industry.

REFERENCES

1. Benz, A. and Fürst, D. (2002), Policy Learning in Regional Networks, European Urban and Regional Studies, Vol. 9, pp. 21-35.
2. Carayannis E. and Alexander, J. (2006), Global and Local Knowledge: Glocal Transatlantic Public – Private Partnerships for Research and Technological Development, Palgrave Macmillan, Basingstoke.
3. Chen, T.-C. (2005), There Is an Urgent Need to Create Adding Value of Tourism In Taiwan, Epochtime News, July 15, 2005.
4. Chen, C.-C., and Chen, C.-Y. (2008), An Empirical Study of the Relationships among Service Quality, Trust, and Customer Loyalty in Taiwan International Tourist Hotel, Journal of Sport and Recreation Research Vol. 3, No. 2, pp. 163-181.
5. Chen, H.-L., and Wu, Y.-W. (2009), An Examination of the Relationship be1tween Service Quality and Recreation Experiences among Visitors: The Case of B&B Accommodation in Wutai, Marketing Review, Vol. 6, No. 2, pp. 299-327.
6. Chih, W.-H. Chang, S.-H. and Wu, W.-L. (2006), The Study of Consumer Experience of the Tourist Recreation Hotels, Soochow Journal of Economics and Business, No. 67, pp. 47-77.
7. ComScore (2009), Analytics for a Digital World, comScore, Inc. http://www.comscore.com/
8. Dai, T.-Y. (2008), Characteristics of medium and small-size corporates in Taiwan, Taiwan Research Institute Website.
9. Dehning, B., Richardson, V.J., and Stratopoulos, T. 2005. Information Technology Investments and Firm Value. Information & Management, 42 (7), 989-1008.
10. Deng, W.-J., Chiang, S.-Y., Tsai, C.-H., and Tsai, S.-C. (2007), The Relationship of Internal Service Quality, External Service Quality and Overall Customer Satisfaction, Quality Magazine, Vol. 43, No. 10, pp. 52 -58.

11. Hsieh, L.-F., Lin, L.-H., and Lin, Y.-Y. (2008), A Service Quality Measurement Architecture For Hot Spring Hotels In Taiwan, Tourism Management, Vol. 29, No. 3, pp. 429-438.
12. Huang, Y.-C. (2006), The Strategies of Recreational Hotel Operation and Management in Taiwan, Association of Taiwan Journalists Website.
13. Hwang, S.-N., and Chen, Y.-C. (2009), Effects of Salary and Compensation System Equity on Job Satisfaction and Turnover Intention for Frontline Employees of a Tourist Hotel, Journal of Hospitality and Home Economics, Vol.6, No.4, pp.285-306.
14. Lai, S.-Q. Hsu, L.-L. and Lin, Z.-Y. (2011), ICT's Effect on Knowledge-Based Industrial Cluster Development: An Example of Tainan Cultural Intention Industry, Journal of Business Administration, Vol. 90, pp. 25-52.
15. Landry, C. (2000), The creative city-A toolkit for urban innovators, Earthscan London,
16. Lee, H.-H. (2005), Quality of Food & Beverage Service of Some star-rated Hotels: Problems and Countermeasures, Journal of Zhejiang University of Science and Technology, Vol. 17, No. 3, pp. 204-208.
17. Lee, H.-T. (2010), Research on the Incentive Mechanism for Knowledge Workers, Modern Business, Vol. 2010, No. 5C, pp.162 -164.
18. Lee, L.-C., Song, C.-Q., and Kang, H.-C. (2008), Internet Marketing Strategies for Home Stays, Bio and Leisure Industry Research, Vol. 6, No. 3, pp. 120 -140.
19. Lin, C.-C. and Huang, C.-C. (2009), Culture and Creative Industry, Culture and Creative Products of the Strategy. Plan. Design. Development. The research take "the Taiwan Forever Tree Root-Magic Wooden Workshop" as the example, The Journal Of Commercial Design, Vol. 13, pp. 175-194.
20. Liu, H.-J, and Chen, F.-H. (2011), Reviewed the Advanced Research Park in Nantou to Develop the Cultural and Creative Industries, The Journal of Chinese Public Administration, Vol. 9, pp. 20-39.
21. Liu, C. Yang, J.-W. Xia, J.-M. (2011), Study on the Countermeasure and Trend of Chinese Cultural and Creative Industries' Brand, Science & Technology Progress and Policy, Vol. 28, No. 16, pp. 51-56.
22. Lu, C.-H., Chou, Y.H., Lee, C.-H., and Ko, T.Y. (2008), The Study of Home-Stay Manager's Relationship Marketing and Tourist's Choice Behavior in Hualien County, Bio and Leisure Industry Research, Vol.8, No. 4, pp. 64-85.
23. Otto, J.E. and Ritchie, J. R. B. (1996), The Service Experience In Tourism, Tourism Management , Vol. 17, No. 3, pp. 165-174.
24. Rossman, J.R. (1989), Recreation Programming Designing Leisure Experience, 2nd. Edition, Champaign, Illinois: Sagamore Publishing, pp. 289-307.
25. Wu, Y.-H. (2011), The Research of Cultural and Creative Industry to Future of Taiwan, Journal of Chinese Trend and Forward, Vol. 7, No, 1, pp.113-119.
26. Yeh, Y.-I. and Wang, T.-Y. (2001), A Correlational Study of Relationship Quality and Customers' Repurchase Intentions for International Hotels in Kaohsiung, Journal of Outdoor Recreation Study, Vol. 14, No. 4, pp.77-101.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

IS HABIT INFLUENCED CONSTRUCT FOR ONLINE REPURCHASE INTENTION?

Chinho Lin*, Institute of Information Management of National Cheng Kung University, Taiwan, R.O.C.,
linn@mail.ncku.edu.tw

Watcharee Lekhawipat, Institute of Information Management of National Cheng Kung University, Taiwan, R.O.C.,
watcharee_lak@hotmail.com
***Corresponding author**

ABSTRACT

Purpose: *Habit is treated as a construct of marginal focus on attitude, and in particular on the expectancy-value perspective, as antecedents of behavior. In online business context, repeat purchase behavior of customers is critical for the prosperity and survival of online stores; the habitual behavior may be reinforced as a moderator of repurchase intention and adjusted expectations when used by satisfied customers. The purpose of this paper is to investigate the moderating role of online shopping habit on the relationship between customer satisfaction and online repurchase intention, and between customer satisfaction and adjusted expectations.*
Design/methodology/approach: *In this paper, we develop an analytical model that examines the impact of online shopping habit on online repurchase intention and adjusted expectations. The model was tested using structural equation modeling for data collected from 204 respondents.*
Findings: *Our empirical results indicate that online shopping habit is not significant driving forces of online repurchase intention and adjusted expectations, but it has indirect effect through customer satisfaction. In fact, customer satisfaction has a positive effect on online repurchase intention, and adjusted expectations.*
Originality/Value: *Our findings suggest that online shopping habit is necessary but not influence on driving forces of online shopping behavior. In term of post-satisfaction, adjusted expectations have a significant mediating influence on the link of customer satisfaction and online repurchase intention.*

Keywords: Online shopping habit, Customer satisfaction, Adjusted expectations, Online repurchase intention
Paper type: Research paper

INTRODUCTION

In today's competitive market as a consequence of the Internet's significant, online shopping business has transformed from a trendy emerging shopping channel and also become a supplementary shopping channel (Limayem and Hirt, 2003). Recent survey research reveals that critical factor to the success and profitability of online business is customers' repurchasing and loyalty (Chiu et al., 2009). Customers' repurchasing is challenging in context of online shopping. Especially in the current competitive in online business where the

majority of online retail is to drive online buying intention. Therefore, the important to identify the significant determinants of online repurchase intention (Khalifa and Liu, 2007).

The critical factor for a strong bond with customers' online repurchase intention is customer satisfaction (Wen, 2012, Lin et al., 2010, Wen, 2009, Anderson and Srinivasan, 2003). While many researches use satisfaction as an indicator of repurchase (Anderson and Srinivasan, 2003), that is an emotional reaction which influences attitude and provides a pleasurable level of consumption related fulfillment (Oliver, 1997a). Although numerous of prior researches propose that satisfaction serve as the underlying determinant of repurchase intentions (Lin et al., 2010), it is still necessary to examine the customer satisfaction and repurchase intention on online business environments (Ha et al., 2010). In online context, the link between customer satisfaction and repurchase intention seems to be more complicated (Anderson and Srinivasan, 2003, Hennig- Thurau and Klee, 1998) and our understanding of mediating roles between customer satisfaction and repurchase intention, which is also for shopping behavior, is much more limited (Kaveh et al., 2012).

In prior research about repeated behaviors, habits as the role in explaining repurchase intention (Gefen et al., 2003, Limayem and Hirt, 2003) when behavior is repeated and becomes habitual, it considered by automated cognitive processes in which a habit is practiced (Khare and Inman, 2005). Some researchers suggest that a weak habit may lower the sensitivity of consumer retention to satisfaction (Anderson and Srinivasan, 2003), the habit construct is also of appeal to practitioners. Thus, examining the effect of habit on online repurchase intention can improve our understanding of online business.

To fill this knowledge void, this research attempts to examine how adjusted expectations mediate the impact of customer satisfaction on online repurchase intention link in a post-purchase. Specifically, we adopt a contingency approach to examine whether online shopping habit moderates the relationships among customer satisfaction, adjusted expectation and online repurchase intention.

In the next sections, we provide a description of the background theory about this research and develop a series of hypotheses. We describe our research method in section 3. Then, the last two section present data analysis and results, followed by a discussion of the research implication, and limitation and future research.

THEORETICAL BACKGROUND AND HYPOTHESIS

The last decade has seen an increasing body of theory-based research on online shopping intention. While online retailers often face a challenge about how to acquire and retain customers (Tsai and Huang, 2007, Chen and Hitt, 2002, Keaveney and Parthasarathy, 2001, Bolton et al., 2000), and drawn from psychology, expectancy disconfirmation theory, attitude-behavior model and a contingency theory to develop the model; fig.1 presents our conceptual research model; the development of this model is established in online customer retention. This study extends prior research models with applying expectancy disconfirmation which more detailed analyses the relationships between customer satisfaction and repeat purchase in online environment. In addition to, we apply the adjusted expectations, which are expectations updated on online post-purchase (Yi and La, 2004) as the link between customer satisfaction and online repurchase intention. In this research model, we recognize the

complicated online consumer behavior phenomenon (Darley et al., 2010), and customers focus on the satisfaction rather than emphasis on technology (Porter, 2001, Wind and Mahajan, 2002, Grant et al., 2007). Following a contingency theory and attitude-behavior model, we extend Khalifa and Liu (2007) the model by capturing the moderated effects of online shopping habit.

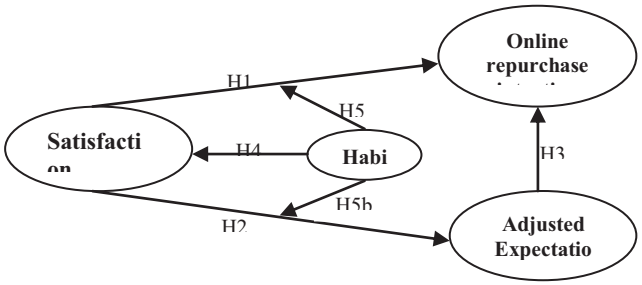


Figure1: Research model

1. Customer satisfaction and online repurchase intention

It is important for retailers to understand customer's repurchase intention and the factors that influence repurchase intention (Patterson et al., 1997) because increased repurchased encourage profitability and achieve customer loyalty. Repurchase is also significant to continue the flow of the company's profitability (Hansemark and Albinsson, 2004). Prior research literatures have yielded several key antecedents as influencing a customer's intent to repurchase (Petrick et al., 2006, Tam, 2004, Eggert and Ulaga, 2002) such as customer satisfaction, service quality, perceive value, past experience/behavior, etc.

A number of researchers have stated that traditionally customer satisfaction is proposed as the most significant factor leading to the firm's profit and repurchase intent (SurabayaUniversity, 2012). Martínez Caro and Martinez Garcia (2007) indicate that customer satisfaction has been driven by cognitive and affective beings, where some comparison standard is compared to the actually perceived performance (Homburg and Giering, 2001).

Based on online environment, Customer satisfaction is one of the key criteria that is significant for online shopping operators (Mihelis et al., 2001), it has been used to increase profitability and long-term growth of any online retailers and strongly related to identifying future intention. Improving customer satisfaction is essential for increasing customer revisits, and crucial for repurchase intention (Gupta and Kim, 2010). Hence, the understanding of factors affecting to online customer satisfaction is important to online retailers for predicting customer behavior or behavioral intention and to respond the need for explaining the post adoption behavioral decision and provide a view of customer satisfaction in online shopping. Therefore, we propose the following hypothesis.

H1. Customer satisfaction has a positive effect on online repurchase intention.

2. Customer satisfaction and adjusted expectations

Yi and La (2004) have defined adjusted expectations, which are updated from the initial expectations as new information is acquired or expectations updated through accumulated consumption experiences as "post-purchase satisfaction." From expectancy-disconfirmation theory is that expectations are understood as an antecedent of customer satisfaction and it acts as the standards in evaluating satisfaction on consumption experience (Oliver, 1980, Yi, 1993), whereas adjusted expectations play the role of post-satisfaction judgments that are the expectations adjust over time through accumulated or current consumption experiences (Jones and Sasser, 1995, Yi and La, 2004).

The basis of the preceding discussion, we focus on conceptualize adjusted expectations that affected by customer satisfaction. Therefore, we propose following hypothesis.

H2. Customer satisfaction has a positive effect on adjusted expectations.

3. Adjusted expectations and online repurchase intention

There is at present little online shopping research that using of adjusted expectations (Ha et al., 2010) to illustrate consumer behavior instead of initial expectations is relevant given the similarity ways in which both types establish their causal relationship with satisfaction and repurchase intention. In the marketing area, the individuals' expectations change quickly (Johnson et al., 1995), so a revision of individual expectations can occur even during consumption (Oliver, 1997b).

Especially in online environment, retailers need to enhance consumers' expectations in order to lead them to repurchase, the more customers have good experiences and feelings, and the higher expectations are adjusted according to the increasing repurchase expectations from the great expectation of customer (Rust and Oliver, 2000, Szymanski and Hise, 2000). Therefore, we propose following hypothesis.

H3. Adjusted expectation has a positive effect on online repurchase intention.

4.Online shopping habit and customer satisfaction

The concept of habit has been studied in various disciplines, such as psychology, social psychology, consumer behavior, organizational behavior and information systems (Limayem et al., 2007). (Limayem and Hirt, 2003). In the previous research, Limayem and Hirt (2003) proposed that habit is major driver of affect. Affect represents to emotions, feelings, moods and attitudes of customer (Chen and Cheng, 2012). It suggests that customer satisfaction is affecting (Bhattacherjee, 2001). By increasing a favorable feeling towards a behavior (Triandis, 1971), habit affects satisfaction directly (Limayem and Hirt, 2003).

Habit also has been used to predict consumption behavior in online context. For example, Liao et al. (2006) showed that consumers' intention to continue using a B2C web site is determined by its perceived usefulness, trust and habit. In online shopping, individual with online shopping habit would turn to the behavior response instead of a physical outlet automatically without further consideration when they feel shopping needs (Khalifa and Liu,

2007). In this study, online shopping habit can be viewed as an automatic behavioral response as it has become spontaneous in online shopping due to the learned association between the shopping behavior and satisfactory results (Aarts et al., 1998, Wood and Neal, 2007, Verplanken, 2006). Therefore, the following hypothesis is proposed.

H4.Online shopping habit has a positive effect on Customer satisfaction.

5. Moderating roles of online shopping habit

Prior research has explored the moderating role of habit. For instance, Khalifa and Liu (2007) examined the moderating role that habit plays between satisfaction and online repeat purchase intention. They suggested that satisfaction may not necessarily lead to an intention to return to an online store in the absence of habit. The influence of the determinants of online repeat purchase intention may be contingent upon the development of the habit of using the online channel (Chiu et al., 2012), and thus the importance of customer satisfaction will increase. In other word, online shopping habit positively moderates the relationship between customer satisfaction and online repurchase intention.

H5a. Online shopping habit positively moderates the relationship between customer satisfaction and online repurchase intention.

There is at present no online shopping research that testing of the role of habit on relationship between customer satisfaction and adjusted expectations. In cognitive judgment process expectations are understood as an antecedent of customer satisfaction, whereas adjusted expectations which are advocated a new paradigm of post-satisfaction judgments that customer expectations adjust over time through accumulated and current consumption experiences (Johnson et al., 1995). When once a behavior has become a habit, it implies a well-practiced behavior (Ouellette and Wood, 1998). Customer satisfaction is influenced from prior experiences (Lee et al., 2008, Jang and Namkung, 2009). Therefore, habit should be included as a potential moderating effect. Consequently, this study argues that online shopping habit positively moderates the relationship between customer satisfaction and adjusted expectations. Thus, we propose following hypothesis.

H5b. Online shopping habit positively moderates the relationship between customer satisfaction and adjusted expectations.

RESEARCH MEDTHOD

This section describes the research methodology employed to test the conceptual model of this study is shown in Figure1, Online shopping survey and structural equation modeling (SEM) were exploited to test the model. The concept model for this study is first described, followed by description of the measurement development and data collection respectively.

1. Measurement development

The research model contains 4 constructs including a moderator – online shopping habit. In order to measure online shopping customer perceptions, the questionnaires were formulated based on relevant literature to obtain validity. The key constructs of the research model

namely, online shopping habit, customer satisfaction, adjusted expectations, and online repurchase intention. The respondents were asked to think of a specific online store from which they had previously shopped.

To measure the various constructs, validated items were adapted from extant studies and revalidated for this study. All the focal constructs of the model were measured using reflective constructs that were adapted from the literature and designed using a seven-point Likert scale to facilitate measurement, with a rating scale from (1) "strongly disagree" to (7) "strongly agree."

The measurement for online repurchase intention was draw from Limayem et al. (2000) and Khalifa and Liu (2007); it was measured the future propensity of a customer to repeat purchase intention at a specific intention online store from which he/she had extant shopped by using three items that have been common to measure future intention as indicators of actual behavior. The scale for measurement online shopping habit was draw from Khalifa and Liu (2007), Triandis (1979) indicated that habits can be measured by the automatic behavior tendencies developed during the past history of individual and it also has and interactive effect.

Customer satisfaction construct was defined as a cognitive and affective response to the consumptions experience. The four-item for this construct were adapted from the satisfaction measure developed by Bhattacherjee (2001), these were designed to assess users' attitude with the evaluate product. Another scale to measure for adjusted expectations construct that the literature showed a considerable controversy concerning certain relationships that were established in cognitive-affective models of consumer behavior. With eight-item adapted from Bhattacherjee (2001), these were measured the updated expectations of prior expectations after the consumption experience. Detailed descriptions of actual wording and response scales are given in Appendix A.

2. Data collection

The information and data for this study is general Taiwanese customers who had shopping experience through Internet shopping. The online shopping has been an expansion and explosive growth of online shopping malls (Chen et al., 2009, Kwon and Chung, 2010). Purchasing a product through an online channel is popular in Taiwan, and the approximate number of people involved in online shopping exceeded 3.285 million in one month during 2009 (Chen, 2012). According to the report of the Marketing Intelligence Center (MIC) showed that the B2C e-commerce market value of Taiwan in 2011 was estimated to reach NTD 250 billion (US$8.33 billion) in 2011 (Li, 2011).

Due to this research focuses on the cumulative customer satisfaction construct and the purpose of this study was to examine the effect of purchase importance on satisfaction, post-purchase evaluation in adjusted expectations and the effect of online shopping habit in the repurchase intention. Therefore, our research respondents from the survey composed of 204 Taiwan online customers who had previously shopped at least four times in buying products or services from a specific online store. They came from various demographic areas of Taiwan and consisted of 129 females and 75 males. The respondents are relatively young: about 96 percent of all are lower 35 years old and quite experienced in Internet usage, with 97

percent of more than 4 years of Internet experience. About 62 percent online shoppers have a few times of online shopping in a months.

ANALYSIS RESULTS

This analysis of the data was analyzed by partial least square (PLS), a structural equation modeling (SEM) technique. The PLS procedure (Wold, 1989) has gained interest and use among researchers in recent years because of its ability to model latent constructs under conditions of non-normality and small to medium sample size (Chin and Gopal, 1995, Chin, 1998b). It allows the researchers to explain the relationship within a model (Fornell and Bookstein, 1982) and assesses the relationship between constructs and between the constructs and their measurement items; it also enables a simultaneous analysis of whether the hypothesized relationships at the theoretical level are empirically confirmed (Liu and Khalifa, 2003). This ability to include multiple measures for each construct also provides more accurate estimates of the path among constructs are provided typically biased downward by measurement error when using techniques such as multiple regression (Limayem et al., 2001). Furthermore, PLS can accommodate the presence of moderating effects, SmartPLS 2.0 M3 was used for our analysis. The bootstrap resampling method (500 resamples) was employed to determine the significance of the path within the structural model.

1. Measurement validation

We used PLS method to assess the psychometric properties of all scales used in this study. A set of deliberation in PLS methods was to evaluate on the criteria of reliability, convergent validity and discriminant validity (Fornell and Larcker, 1981, Chin, 1998a, Hulland, 1999) using composite reliability, factor loading, and average variance extracted (AVE).

The research model consisted of four latent variables which they employed reflective measurement model and performed on each of the multiple-item scales. For the measurement model, the adequacy of the measures can be determined by examining the individual item reliabilities, which is represented by the loading to the respective construct. The standardized loadings of each item should be greater than 0.7 (Chin, 1998b). Table 3 shows the item loadings obtained the model with all constructs. The results show that all items are reliable with loading over 0.7.

In evaluation of the internal consistency, which is an indicator of reliability of the combined test items used to measure each specific construct. The composite reliability (CR) scores clearly indices exceeded the recommended value of 0.70 which demonstrating adequate internal consistency of the scales (Chin, 1998a). From table 2 below, it shows the result of all constructs are of very high degree of reliabilities (all of them are above 0.90) and internal consistency. The convergent validity of the scales was assessed by two criteria (Fornell and Larcker, 1981): (1) all indicator loadings should be significant and exceed 0.7 and (2) the average variance extracted (AVE) by each construct should exceed the variance due to the measurement error for the construct (i.e., AVE should exceed 0.50). Table 2 shows that all of the items exhibit a loading higher 0.7 on their respective constructs, and the AVEs range from 0.70 to 0.92. Thus, these data allowed the conclusion that the constructs had appropriate reliability and convergent validity.

To ensure the discriminant validity, we examined by using the following two tests. First, the cross-factor loadings indicate good discriminant validity because the loading of each measurement item on its assigned latent variable is larger than its loading on any other construct (Chin, 1998a). Second, the square root of the AVE from the construct should be greater than the correlation between the construct and all other constructs. The correlations between the relevant constructs are significant lower than the square root of the average variance extracted. Therefore, the discriminant validity of the constructs is well established.

2. Testing the structure model

The standardized PLS path coefficient and R^2 value, which are differently estimated without the moderating effects of online shopping habit, are denoted in parentheses.

As predicted, the estimates obtained using the structural model support the view that customer satisfaction (β = 0.493, p < 0.001) significantly influence online repurchase intention, and it (β = 0.746, p < 0.001) significantly influence adjusted expectations, which accounts for 65.8% and 64% of the variance respectively. Therefore, customer satisfaction had positive effect on online repurchase intention and adjusted expectations to recommend support H1 and H2. Furthermore, online repurchase intention is significantly influenced by adjusted expectations (β = 0.335, p < 0.01), which accounts for 65.8% of the dependent variable's variance, which to recommend support H3.

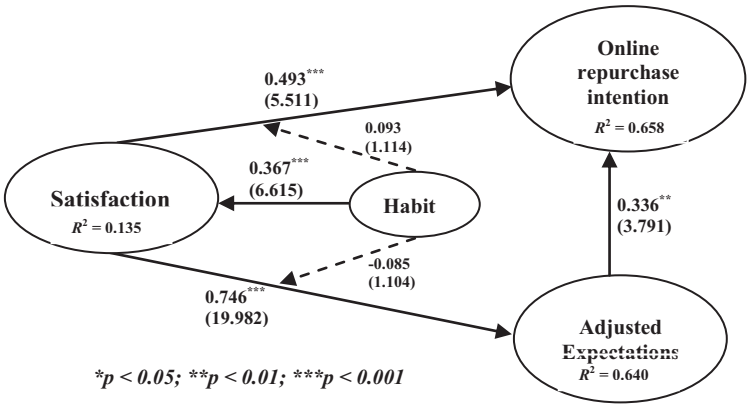


Figure2: PLS results for proposed research model

Further, we also examine the effect the online shopping habit on customer satisfaction. Online shopping habit significantly influence customer satisfaction (β = 0.367, p < 0.001), accounting for 13.5% of the variance. Finally, all interaction indicators were computed in order to reflect the latent interaction variables (Chin et al., 2003). For example, because four indicators represent customer satisfaction and three indicators represent online shopping habit in our measurement model, the procedures will generate twelve indicators reflecting the interaction term, i.e. online shopping habit *x* customer satisfaction. The moderating roles of online shopping habit were not supported. Online shopping habit insignificantly reinforces the positive impact of customer satisfaction on online repurchase intention (β = 0.093) and adjusted expectations (β = -0.085) respectively.

DISCUSSION

The paper employs contingency approach and synthesizes other prior research on online post-purchase regarding online shopping habit that moderates the relationship between customer satisfaction and adjusted expectations with regard to their individual effect on online repurchase intention. The findings suggest that customer satisfaction plays key roles both in direct and indirect effect on online repurchase intention. Furthermore, online shopping habit moderator is found to be insignificant.

The results provide empirical support for previous studies. Customer satisfaction has a positive effect on online repurchase intention, implying that customer satisfaction is primary driver of repurchase intention; it also has an indirect effect on online repurchase intention through adjusted expectations. We proved our expectation that adjusted expectations have a positive effect on online repurchase intention. this finding is supported by Yi and La (2004) and Ha et al. (2010). Adjusted expectations are considered to be an essential driver of repurchase intention; therefore, it is imperative for online retailers provide to view adjusted expectations as the updated from the initial expectations. In addition to this, our findings confirmed adjusted expectations as mediator between customer satisfaction and online repurchase intention. Due to comsumers' expectations are constantly changing; adjusting to the information they gradually acquire (Sánchez- García et al., 2012). In this context, ther adjusted expectations are updated from the initial expectations as new information is acquired, and are influenced by customer satisfaction (Yi and La, 2004).

IMPLICATIONS

1. Theoretical implications

This study makes three contributions to our understanding of online repurchase intention. The first contribution is the importance of examining customer satisfactions from general attitude prospective. We know that customer satisfaction vary over time, it is well recognized both the cognitive and affective element that response to a product/service stimulus mold consumers' evaluative judgment. Customer satisfaction has a direct positive effect on repurchase intention, where the level of affective exerts a stronger than cognitive. This means that retailers not only should offer a high quality in product/service, but they should also stimulate the emotions to enhance arousal of the customers. Furthermore, satisfaction also has an indirect influence on repurchase intention through adjusted expectations as does expectancy-disconfirmation, which expectations updated through cumulated or current consumption experiences. Transactional customer satisfaction as well as cumulative satisfaction can influence future expectations and thus repurchase intention.

2. Practical implications

Results of this study offer useful implications for practitioners interested in enhancing the value of their offerings by encouraging satisfied customers to engage in repurchase intention.

Customer satisfaction factor drives online repurchase intention. Hence, customers may be segmented into two groups. The first group is satisfied customers and the other group is unsatisfied customers, each of groups should be assigned different marketing objectives and

priority of repurchase efforts. For the satisfied customers group, the primary marketing objective should be continue the customer loyalty by stimulating the emotions of the customers, adding elements of excitement and surprise in order to enhance the arousal of the customers. For unsatisfied customers group, practitioner may enhance the development of specific habit with particular online shop by contributing cognitive and affective beings. To contribute cognitive being, considering that cognitive evaluations of perceived quality are the basis of expectancy-disconfirmation, this means that practitioners should make an effort a high quality service so as to get a more favorable expectancy-disconfirmation, and demonstrated that quality evaluations are positively related to repurchase intention. Additionally, to improve customers' affective state via a function of the level of pleasure and arousal that positively emotions influence on satisfaction.

LIMITATIONS

This study and their results have several limitations and also indicated direction for future research. First, as the scope of our research is based on one Internet shopping website, participants' feedback is only for that specific shopping mall. Thus it is recommended that the sampling frame be expanded to general online shoppers and a wide range of samples and products. A second consideration concerns a possible response consistency bias online that response to one measure in a questionnaire may have a tendency to respond to later measures in a manner they believe to consistent. Such a bias could result in stronger relationship among variables than might actually exist. Third, in this study uses self-reported measures, which may not be the most accurate way to assess affect or future behavior. In addition to, the data are cross-sectional and not longitudinal; the posited causal relationship could only be inferred rather than proven. Fourth, the role of online shopping habit in enhancing repurchase intention may vary across industry contexts, and it may not be as it does in contexts where online shopping remains in its infancy stage.

CONCLUSION

In conclusion, our study examine emphasizes the importance of the roles of adjusted expectations and online shopping habit in the achievement of online repurchase intention. As verified by our data, adjusted expectations mediate the impact of customer satisfaction on online repurchase intention link in a post purchase, whereas online shopping habit is not significant driving forces of online shopping behavior.

Appendix A. Questionnaire items

Online Shopping Habit (HA)
HA1 Shopping online has become a natural act for me.
HA2 Whenever I think of shopping, the Internet comes to my mind.
HA3 Online Shopping has become spontaneous for me.

Customer Satisfaction (CS)
How do you feel about your overall experience of this purchase?
CS1 Dissatisfied to satisfied
CS2 Displeased to pleased
CS3 Frustrated to contented

CS4 Terrible to delight

Adjusted Expectations (AE)
AE1 I now expect this Internet store will provide good after-sale service.
AE2 I now expect this Internet store will provide very efficient transaction processing (e.g., fast retrieval of information, ordering, payment processing and scheduling delivery).
AE3 I now expect this Internet store will be very convenient.
AE4 I now expect the design of this Internet store's website will allow easy navigation.
AE5 I now expect the products offered by this Internet store to be what I will seek.
AE6 I now expect this Internet store to provide descriptions of the products that are very informative.
AE7 I now expect buying online from this store will be a good decision.
AE8 I now expect this website will be an overall pleasing shopping experience.

Online Repurchase Intention (RI)
RI1 I anticipate to repurchase from this Internet store in the near future.
RI2 It is likely that I will repurchase from this Internet in the near future.
RI3 I expect to repurchase from this Internet store in the near future.

REFERENCES

1. AARTS, H., VERPLANKEN, B. & KNIPPENBERG, A. 1998. Predicting behavior from actions in the past: Repeated decision making or a matter of habit? *Journal of Applied Social Psychology,* 28**,** 1355-1374.
2. ANDERSON, R. E. & SRINIVASAN, S. S. 2003. E-satisfaction and e-loyalty: A contingency framework. *Psychology & Marketing,* 20**,** 123-138.
3. BHATTACHERJEE, A. 2001. Understanding information systems continuance: An expectation-confirmation model. *Mis Quarterly,* 25**,** 351-370.
4. BOLTON, R. N., KANNAN, P. & BRAMLETT, M. D. 2000. Implications of loyalty program membership and service experiences for customer retention and value. *Journal of the academy of marketing science,* 28**,** 95-108.
5. CHEN, C. W. & CHENG, C. Y. 2012. How online and offline behavior processes affect each other: customer behavior in a cyber-enhanced bookstore. *Quality & Quantity***,** 1-17.
6. CHEN, L. S. L. 2012. What drives cyber shop brand equity? An empirical evaluation of online shopping system benefit with brand experience. *International Journal of Business and Information,* 7.
7. CHEN, P. Y. S. & HITT, L. M. 2002. Measuring switching costs and the determinants of customer retention in Internet-enabled businesses: A study of the online brokerage industry. *Information Systems Research,* 13**,** 255-274.
8. CHEN, Y. C., SHANG, R. A. & KAO, C. Y. 2009. The effects of information overload on consumers' subjective state towards buying decision in the internet shopping environment. *Electronic Commerce Research and Applications,* 8**,** 48-58.
9. CHIN, W. W. 1998a. Commentary: Issues and opinion on structural equation modeling. *MIS quarterly*.
10. CHIN, W. W. 1998b. The partial least squares approach for structural equation modeling.
11. CHIN, W. W. & GOPAL, A. 1995. Adoption intention in GSS: relative importance of beliefs. *ACM SigMIS Database,* 26**,** 42-64.

12. CHIN, W. W., MARCOLIN, B. L. & NEWSTED, P. R. 2003. A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study. *Information Systems Research,* 14**,** 189-217.
13. CHIU, C. M., HSU, M. H., LAI, H. C. & CHANG, C. M. 2012. Re-examining the influence of trust on online repeat purchase intention: The moderating role of habit and its antecedents. *Decision Support Systems,* 53**,** 835-845.
14. CHIU, C. M., LIN, H. Y., SUN, S. Y. & HSU, M. H. 2009. Understanding customers' loyalty intentions towards online shopping: an integration of technology acceptance model and fairness theory. *Behaviour & Information Technology,* 28**,** 347-360.
15. DARLEY, W. K., BLANKSON, C. & LUETHGE, D. J. 2010. Toward an integrated framework for online consumer behavior and decision making process: A review. *Psychology and Marketing,* 27**,** 94-116.
16. EGGERT, A. & ULAGA, W. 2002. Customer perceived value: a substitute for satisfaction in business markets? *Journal of Business & industrial marketing,* 17**,** 107-118.
17. FORNELL, C. & BOOKSTEIN, F. L. 1982. Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *Journal of Marketing research***,** 440-452.
18. FORNELL, C. & LARCKER, D. F. 1981. Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research,* 18**,** 39-50.
19. GEFEN, D., KARAHANNA, E. & STRAUB, D. W. 2003. Trust and TAM in online shopping: An integrated model. *Mis Quarterly,* 27**,** 51-90.
20. GRANT, R., CLARKE, R. J. & KYRIAZIS, E. 2007. A review of factors affecting online consumer search behaviour from an information value perspective. *Journal of Marketing Management,* 23**,** 519-533.
21. GUPTA, S. & KIM, H. W. 2010. Value-driven Internet shopping: The mental accounting theory perspective. *Psychology and Marketing,* 27**,** 13-35.
22. HA, H. Y., JANDA, S. & MUTHALY, S. K. 2010. A new understanding of satisfaction model in e-re-purchase situation. *European Journal of Marketing,* 44**,** 997-1016.
23. HANSEMARK, O. C. & ALBINSSON, M. 2004. Customer satisfaction and retention: the experiences of individual employees. *Managing Service Quality,* 14**,** 40-57.
24. HENNIG-THURAU, T. & KLEE, A. 1998. The impact of customer satisfaction and relationship quality on customer retention: A critical reassessment and model development. *Psychology & Marketing,* 14**,** 737-764.
25. HOMBURG, C. & GIERING, A. 2001. Personal characteristics as moderators of the relationship between customer satisfaction and loyalty—an empirical analysis. *Psychology and Marketing,* 18**,** 43-66.
26. HULLAND, J. 1999. Use of partial least squares (PLS) in strategic management research: a review of four recent studies. *Strategic management journal,* 20**,** 195-204.
27. JANG, S. C. S. & NAMKUNG, Y. 2009. Perceived quality, emotions, and behavioral intentions: Application of an extended Mehrabian–Russell model to restaurants. *Journal of Business Research,* 62**,** 451-460.
28. JOHNSON, M. D., ANDERSON, E. W. & FORNELL, C. 1995. Rational and adaptive performance expectations in a customer satisfaction framework. *Journal of consumer research***,** 695-707.
29. JONES, T. O. & SASSER, W. E. 1995. Why satisfied customers defect. *Harvard Business Review,* 73**,** 88-&.

30. KAVEH, M., MOSAVI, S. & GHAEDI, M. 2012. The application of European customer satisfaction index (ECSI) model in determining the antecedents of satisfaction, trust and repurchase intention in five-star hotels in Shiraz, Iran. *African Journal of Business Management,* 6**,** 6103-6113.
31. KEAVENEY, S. M. & PARTHASARATHY, M. 2001. Customer switching behavior in online services: An exploratory study of the role of selected attitudinal, behavioral, and demographic factors. *Journal of the Academy of Marketing Science,* 29**,** 374-390.
32. KHALIFA, M. & LIU, V. 2007. Online consumer retention: contingent effects of online shopping habit and online shopping experience. *European Journal of Information Systems,* 16**,** 780-792.
33. KHARE, A. & INMAN, J. 2005. Habit regimes in consumption. *Advances in Consumer Research,* 32**,** 35-36.
34. KWON, S. J. & CHUNG, N. 2010. The moderating effects of psychological reactance and product involvement on online shopping recommendation mechanisms based on a causal map. *Electronic Commerce Research and Applications,* 9**,** 522-536.
35. LEE, Y. K., LEE, C. K., LEE, S. K. & BABIN, B. J. 2008. Festivalscapes and patrons' emotions, satisfaction, and loyalty. *Journal of Business Research,* 61**,** 56-64.
36. LI, J. 2011. Taiwan sees slowdown in e-commerce: MIC, CENS. *http://www.cens.com/cens/html/en/news/news_inner_38661.html*
37. LIAO, C., PALVIA, P. & LIN, H.-N. 2006. The roles of habit and web site quality in e-commerce. *International Journal of Information Management,* 26**,** 469-483.
38. LIMAYEM, M. & HIRT, S. G. 2003. Force of habit and information systems usage: Theory and initial validation. *Journal of the Association for Information Systems (Volume 4, 2003),* 65**,** 97.
39. LIMAYEM, M., HIRT, S. G. & CHEUNG, C. M. 2007. How habit limits the predictive power of intention: The case of information systems continuance. *Mis Quarterly,* 31**,** 705-737.
40. LIMAYEM, M., HIRT, S. G. & CHIN, W. W. Intention does not always matter: the contingent role of habit on IT usage behavior. The 9th European conference on information systems, 2001. Citeseer, 274-286.
41. LIMAYEM, M., KHALIFA, M. & FRINI, A. 2000. What makes consumers buy from Internet? A longitudinal study of online shopping. *Systems, Man and Cybernetics, Part A: Systems and Humans, IEEE Transactions on,* 30**,** 421-432.
42. LIN, C. Y., FANG, K. & TU, C. C. 2010. Predicting consumer repurchase intentions to shop online. *Journal of Computers,* 5**,** 1527-1533.
43. LIU, V. & KHALIFA, M. 2003. Determinants of satisfaction at different adoption stages of Internet-based services. *Journal of the association for information systems,* 4**,** 12.
44. MARTíNEZ CARO, L. & MARTINEZ GARCIA, J. A. 2007. Cognitive–affective model of consumer satisfaction. An exploratory study within the framework of a sporting event. *Journal of Business Research,* 60**,** 108-114.
45. MIHELIS, G., GRIGOROUDIS, E., SISKOS, Y., POLITIS, Y. & MALANDRAKIS, Y. 2001. Customer satisfaction measurement in the private bank sector. *European Journal of Operational Research,* 130**,** 347-360.
46. OLIVER, R. 1997a. Whence consumer loyalty? *J. Mark***,** 63(4): 33–45.
47. OLIVER, R. L. 1980. A cognitive model of the antecedents and consequences of satisfaction decisions. *Journal of marketing research***,** 460-469.
48. OLIVER, R. L. 1997b. Satisfaction: A behavioral perspective on the customer. *New York*.

49. OUELLETTE, J. A. & WOOD, W. 1998. Habit and intention in everyday life: the multiple processes by which past behavior predicts future behavior. *Psychological bulletin,* 124**,** 54.
50. PATTERSON, P. G., JOHNSON, L. W. & SPRENG, R. A. 1997. Modeling the determinants of customer satisfaction for business-to-business professional services. *Journal of the Academy of Marketing Science,* 25**,** 4-17.
51. PETRICK, J. F., TONNER, C. & QUINN, C. 2006. The utilization of critical incident technique to examine cruise passengers' repurchase intentions. *Journal of Travel Research,* 44**,** 273-280.
52. PORTER, M. E. 2001. Strategy and the Internet. *Harvard business review,* 79**,** 62-79.
53. RUST, R. T. & OLIVER, R. L. 2000. Should we delight the customer? *Journal of the Academy of Marketing Science,* 28**,** 86-94.
54. SáNCHEZ-GARCíA, I., PIETERS, R., ZEELENBERG, M. & BIGNé, E. 2012. When Satisfied Consumers Do Not Return: Variety Seeking's Effect on Short-and Long-Term Intentions. *Psychology and Marketing,* 29**,** 15-24.
55. SURABAYAUNIVERSITY, B. 2012. Effect of servicescape and employee communication quality on customer loyalty of Mandiri Bank in Surabaya. *Academic Research International,* 2**,** 229.
56. SZYMANSKI, D. M. & HISE, R. T. 2000. E-satisfaction: an initial examination. *Journal of retailing,* 76**,** 309-322.
57. TAM, J. L. M. 2004. Customer satisfaction, service quality and perceived value: an integrative model. *Journal of Marketing Management,* 20**,** 897-917.
58. TRIANDIS, H. C. 1971. Attitude and attitude. *Change. New York: John Wiley*.
59. TRIANDIS, H. C. Values, attitudes, and interpersonal behavior. Nebraska symposium on motivation, 1979. University of Nebraska Press.
60. TSAI, H. T. & HUANG, H. C. 2007. Determinants of e-repurchase intentions: An integrative model of quadruple retention drivers. *Information & Management,* 44**,** 231-239.
61. VERPLANKEN, B. 2006. Beyond frequency: Habit as mental construct. *British Journal of Social Psychology,* 45**,** 639-656.
62. WEN, I. 2009. Factors affecting the online travel buying decision: a review. *International Journal of Contemporary Hospitality Management,* 21**,** 752-765.
63. WEN, I. 2012. An empirical study of an online travel purchase intention model. *Journal of Travel & Tourism Marketing,* 29**,** 18-39.
64. WIND, Y. & MAHAJAN, V. 2002. Convergence marketing. *Journal of Interactive Marketing,* 16**,** 64-79.
65. WOLD, H. 1989. Introduction to the second generation of multivariate analysis. *Theoretical empiricism***,** 7-11.
66. WOOD, W. & NEAL, D. T. 2007. A new look at habits and the habit-goal interface. *Psychological review,* 114**,** 843.
67. YI, Y. 1993. The determinants of consumer satisfaction: the moderating role of ambiguity. *Advances in Consumer Research,* 20**,** 502-506.
68. YI, Y. J. & LA, S. 2004. What influences the relationship between customer satisfaction and repurchase intention? Investigating the effects of adjusted expectations and customer loyalty. *Psychology & Marketing,* 21**,** 351-373.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

PRODUCT PORTFOLIO MANAGEMENT - CURRENT CHALLENGES AND PRECONDITIONS

Arto Tolonen*, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610, FI-90014, Finland
Email: arto.tolonen@oulu.fi

Hanna Kropsu-Vehkapera, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610, FI-90014, Finland
Email: arto.tolonen@oulu.fi

Harri Haapasalo, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610, FI-90014, Finland
Email: harri.haapasalo@oulu.fi
***corresponding author**

ABSTRACT

Purpose: *The main objective of this study is to clarify the current challenges relating to Product Portfolio Management (PPM). Also, any preconditions for active PPM in terms of concepts, processes, tools, KPIs and governance models are analyzed.*
Design/methodology/approach*: Current state analysis of product portfolio management practices are based on both, a thorough literature review and several case companies. Case companies represent many business areas such as HW, SW, services and even combinations of them, solution providers.*
Findings: *The role of PPM is not to be a follower of activities caused by customers, product development, sales, deliver and care organizations, and processes. The primary role of PPM should be active management of current product portfolio, over product life cycle, instead of merely focusing on new product development. Product portfolio management as a concept and process is not that well understood and in place like other business processes.*
Research limitations: *The limitations of this study include analyzing a limited number of companies. Also, the experience of the analyzed companies varies from only few years to a relatively long history.*
Practical implications*: The implications of this study include the potential preconditions of clarifying the role of product portfolio management. The findings can aid business managers in understanding the PPM as an entity that has a role in managing products and portfolios based on strategic and financial targets over product lifecycles.*
Originality/value: *This study approaches PPM from a more comprehensive viewpoint than the traditional NPD focused PPM that is mainly covered by the existing literature. A company's future portfolio is seen as a sum of the existing product portfolio and the products created via NPD. Existing product portfolio is also expanded by possible products introduced by joint ventures. This article questions whether PPM ought to be considered equally as a business process, similarly as product, sales, delivery and care processes.*

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

Key words Active product portfolio management, Product Portfolio, Product management, Strategic Management and Key Performance Indicators (KPIs)
Paper type Research Paper

INTRODUCTION

New products are seen vital for securing a company's competitive position in the market (e.g. Balachandra et al., 1997; Poolton and Barclay, 1998; Lynn et al., 1999), while development of new products is strongly driven by various customer requirements. However, there are also several other drivers that initiate product development (e.g. Majava et al., 2012). Aside new product development, also existing products are upgraded frequently to achieve cost reductions and improve product performance (Hänninen et al., 2012). Today, also company mergers and acquisitions are meaningful ways to enter new markets and widen a company's product portfolio without conducting new product development. This kind of environment leads easily to widening product portfolios as has occurred in several industries during the recent decades. (e.g. den Hartog, 2012).

The common belief is that a diverse product portfolio will have a positive effect on a company's sales volumes. A wide product offering is seen to allow reaching many customer segments and a larger market share. A high product variety is thought to stimulate sales by segmenting customers and attracting variety-seeking shoppers. (Wan et al., 2012). This coin also has its other side that is often ignored in the discussion. In fact, internal product variety and complexity usually reduce sales per product variant. (Cooper and Griffiths, 1994; Randall and Ulrich, 2001; Thonemann and Bradley; 2002; Pil and Holweg, 2004; Wan et al., 2012). Product variety is often justified by fulfilling customers' requirements. However, too wide product range can lead to mass confusion by the customers, thus weakening sales (e.g. Jiao et al. 2007, Wan et al. 2012). One example of the positive effects of reducing this type of mass confusion is Procter and Gamble increasing its sales by 10 % by reducing the number of versions of its Head and Shoulders shampoo from 26 to 15 (Wan et al. 2012).

Product variety has emerged as a source of competitive differentiation responding to the requests for increasingly customized products and services, when the variety is even desired (Hayes et al., 2005). One aspect that is often ignored in the literature is managing the product plans, products under development, and products in the market over the product life cycles, from an end–to-end viewpoint. Today, companies are often too focused on managing single products instead of managing the entire product range. Consequently, companies could benefit from considering several product families rather than separately optimizing each product. (Salvador et al., 2002).
This research paper aims to analyze the current main challenges of product portfolio management faced by companies. This article analyses the PPM practices of selected case companies. Process management methodology is used as a base frame for the used interview questionnaire. Challenges identified based on the interviews are classified to clarify the most common and significant ones. Product Portfolio Management, as any other processes, requires availability of certain building blocks as preconditions. This paper also aims to clarify these

preconditions to further improve product portfolio management practices over the product life cycle.

The above discussion can be condensed into the following research question:
RQ1. What are the challenges related to product portfolio management?
RQ2. What are the preconditions for product portfolio management?

This study addresses the research questions by using a qualitative approach, through case company interviews and a literature review.

EARLIER RESEARCH

1 Product Portfolio Management

Portfolio management approach can be applied in various areas to manage a set of activities conducted by the same pool of resources (Vähäniitty, 2006). The main objectives of portfolio management can be defined as 1) maximizing the value of portfolio, 2) balancing the portfolio, and 3) linking the portfolio to business strategy (Cooper et al., 1997a).

In addition, portfolio management can be seen as a higher management level decision making process for managing uncertainty, dynamic opportunities, strategic goals, and interdependencies between portfolio items to obtain clear decisions based on agreed criteria (Cooper et al., 2001).

Products can be evaluated based on their strategic importance and ability to become top class products. Also, resources should be allocated to products according their business value. (Ward and Peppard, 2002).

2 Product Portfolio Management challenges

Many product portfolio related challenges have been presented in Hewlett-Packard's portfolio management and operations research (Ward et al., 2010). According Ward et al. (2010) the following challenges have been identified for offering multiple similar products: 1) increase of overall demand volatility, 2) reduced forecasting accuracy, 3) impact to revenue and cost of the product over life cycle, 3) increase in inventory-driven costs and order-cycle time, 4) increased liabilities to channel partners, 5) increased cost for operations, R&D, marketing and administration, and 6) complexity of product lines that confuses customers, sales representatives, channel partners and even driving business to competitors.

Ward et al. (2010) also present solutions to overcome these challenges. These solutions are grouped into managing product portfolio by a "complexity ROI calculator" within product creation life cycle, and managing product variations by a "revenue coverage optimization tool" after product launch.

The interests towards product portfolio management have increased due to many negative side effects of the portfolio management not being done properly. Cooper et al. (2001) have listed the

following negative aspect such as a) missing strategic criteria in project selection resulting in unimportant and low value projects and too many of them and b) deficient go/kill decisions for low value projects resulting in too many extensions, modifications, enhancements, short term projects and lack of focus.

One of the challenges of product portfolio management is the lack of consistent interest and understanding by senior management). Senior management involved in technology is seen to have the most important role in PPM, followed by senior management in general, and corporate executives. Marketing and Sales managers are seen to have the least important role as they are seen to operate at the customer front end, with a clear role in project selection and portfolio management. (Cooper et al., 2001).

One of the most significant weaknesses of existing commercial IT-solutions for PLM is poor support of product life cycle activities outside the actual product development process. Second significant gap is the integration of mechanic, electronic, software, and services components, and elements such as the full view over products. (Saaksvuori, 2011).

3 Process management approach for creation of building blocks for active product portfolio management

The "three levels" of performance: organization, process and job/performer levels can be seen as an ecosystem dimension to business performance (Rummler and Brache, 1990). According to Rummler and Brache (1990) organizations produce their outputs through cross functional work processes, organizations being only as good as their processes. Processes are performed by individuals holding various jobs. Rummler and Brache (1990) also present three "performance needs" of goals, design (structure of organization, processes and individuals,) and management based on clear KPIs. According to Rummler and Brache (1990) is the criticality of cross functional processes to the quality, productivity, cycle time, and cost of any company.

The success of improvement projects are based on project management sitting on the seat of three legs; people, process and technology. The organization strategy and goals of processes to be linked together. People to perform the tasks according processes and related performance metrics to be capable to make things on more predictive way rather than proactive. The foundation for the framework is organizational strategy and process architecture. (Jeston and Nelis, 2008).

Improvements can be done in two different ways in principle such as by breakthrough type of approach or by continuous improvement. Business Process Re-engineering (BRP) has been utilized for more radical changes. The BRB methodology includes several phases: reaffirmation of the vision, core process identification, process analysis, process re-design, blueprinting and implementation planning. (Slack et al. 2012).

According to Jeston and Nelis (2008) the foundation for Business process management consists of following building blocks: 1) process leadership, 2) process governance, 3) process

performance, 4) strategic alignment, 5) people capability, 6) project execution, and 7) technology.

The building blocks for active product portfolio management can be formed as following: a) strategy and key performance indicators, b) organization and people as governance model, c) core processes and tools including technology and information systems.

RESEARCH PROCESS

The research process is shown in Figure 1.This research is qualitative in nature. Product and product portfolio management was first studied by using the existing literature as a key source. The empirical study consists of industrial interviews.

Figure 1. Research process.

Process management theory and approach was utilized to create a comprehensive questionnaire for the empirical part of the study and to analyze whether the current practices apply process management methodologies. The viewpoints are organization, processes, target setting and key performance indicators. Also the question about data availability has been taken into analysis.

Five selected companies (Table 1) were interviewed to clarify the current practices and challenges related to product portfolio management. The interviews were recorded, extracted and transcribed to enable thorough analyses. The selected five companies represent both large/global and small/growing businesses working in different areas such as solutions, HW, SW, and Services products, or all of them simultaneously. The number interviewees are dependent on the size of the case company. In bigger companies the interview has been conducted as work shop of cross functional group of managers while in smaller companies only CEO, R&D manager or Product Management have been interviewed.

Table 1. Company characteristics

Company	Portfolio characteristics	Operational maturity	Interviewees' responsibility areas/roles	Number of interviewees
A	Small portfolio of HW products and related emerging service business managed directly by CEO	New national rival in mature business	CEO	1
B	Large portfolio of solutions, HW, SW and Services products under strategic renewal.	Experienced global innovator in mature business with strong R&D investments	PPM development manager, product data manager, F&C manager, product manager (2), Process dev manager (2)	7
C	Small innovative portfolio of SW products	Growing international presence in growth business	CEO, R&D manager	2
D	Small portfolio of HW and SW products	Experienced growing company in growing global business	R&D manager	1
D	Medium size HW product portfolio under strategic renewal	Experienced global leader in declining business, new growth and business potential via portfolio renewal	Product Management Manager	1

Based on the interview material, high-level product portfolio management challenges and requirements were identified by using inductive logic. The findings were grouped based on process management approach.

RESULTS AND ANALYSIS

Portfolio management challenges

All interviewed companies see potential for improvement in their product portfolio management. The results are presented following similar process management methodology and structure as in the interview questionnaire. Product portfolio management challenges generic to all interviewed companies are presented using the following five sub groups:

1) Product portfolio challenges in general
2) Product portfolio management challenges related to processes and tools
3) Product portfolio management challenges related to ownership and governance models
4) Product portfolio management challenges related target setting and key performance indicators (KPIs)
5) PPM challenges related to data availability

1 Portfolio management challenges in general

Product portfolio management is seen as a generic challenge in case companies regardless of the size, maturity and history of the company. Product portfolio management is viewed nearly non-existent, not only from processes and tools perspective, but from strategic target setting and follow up, ownership and governance model point of view. **The idea and the role of PPM as higher level analysis and decision making process for the entire product portfolio including new and existing products is not thoroughly understood.**

The entire product portfolio and sub portfolios have been not clearly defined and agreed while different groups of products, units, modules and technologies have been called as portfolios. Overall, the visibility over product portfolio as a whole is not seen to be consistent.

The size and proliferation of the product portfolio are seen as the most common challenges in case companies. In some cases, even when the company is relatively new, they have already too many products to be maintained and updated compared to their capabilities. In this type of cases the total revenue share per product decreases. Products and their technical relations to each other are seen even more complicated to maintain. Several versions of same products are simultaneously sold and produced over many years resulting in **cannibalization** within product families, and even outside them. Product cannibalization is not planned and managed consistently, resulting in negative product business cases and/or obsolete materials. Usually the management focus has been more on new products ramp ups while the removal of old products has not been given adequate attention. In an ideal situation, product ramp down activities are done in a synchronized manner with ramp ups (phase in / phase out management).

Lack of product portfolio level business case thinking is seen to exist. The focus has been more on single components, modules, units and products rather than on an entire product portfolio. **The durations of product life cycles** are seen not to be planned in original business

plans for new products. Companies have simply followed their customers' behavior and their requirements.

Product portfolio management is tightly connected to concepts and methods applied in product life cycle management and product data management. **The reporting capabilities** on portfolio, sub-portfolio and product levels are seen dependent on product data management concepts and data structures. In some cases, the required data would even be available but existing design, PDM, configurator and ERP –tools are not utilized consistently in reporting.

The clean-up and renewal of product portfolio is seen as a company level challenge that requires strong leadership from top management. Lack of clear ownership for product portfolio management and product management decreases the capabilities to manage and **communicate the change** efficiently in co-operation with main stakeholders such as R&D, Sales, Operations and Services.

The above described challenges are common for the analyzed case companies. Table 2 summarizes challenges that are more specific for the individual case companies. .

Table 2. Company specific challenges on product portfolio management in general.

A	no company specific challenges – only common challenges exist
B	partly separated HW and SW product development road maps, fast technology and cost reduction initiatives, compatibility challenges, too short life cycles per product version to reach positive breakeven
C	lack of visibility and understanding on customer demand, opportunities for cross selling not well utilized, connection to end user experience and their behavior exist only in narrow local area
D	the way how product portfolio and saleable products have been structured and coded impacts the size of product portfolio and the capabilities of delivering right products
D	no company specific challenges – only common challenges

2 Processes and tools related challenges in PPM

Business processes such as R&D (also referred to as product process), Sales, Deliver and Services processes are seen to be described at a higher level, and even structured in more detail as sub processes in most of the case companies. The challenge is not seen to be the lack of process management theory and overall practices. **Process management concepts and descriptions have been not been implemented for the entire product portfolio management** due to lack of overall understanding product portfolio management concepts. Product decisions and activities have been done more in an ad-hoc and intuitive manner, and in bigger companies at the lower levels of business units. Due to lack of processes, product decisions are done too

quickly and without real analysis of the market demand and understanding the potential for profitable business.

Only a couple of strategic and tactical product portfolio management tools have been utilized by the case companies. For the entire product portfolio evaluation the most typical and used tool is a "product road map", in all case companies. For the evaluation of individual product development projects the "state gate process" –approach has been used by only some of the case companies.

The above mentioned challenges are common in the case companies. There are not many specific challenges related to processes and tools due lack of product portfolio management process as such. Some more specific challenges experienced in case companies on processes and tools are summarized in table 3.

Table 3. Company specific challenges related to portfolio management processes and tools.

A	only one product layer modeled and managed by current ERP tools (which is the main data source), product portfolio cannot be modeled, evaluated and managed as full structure from top to down, overall main business processes have not been described yet
B	product portfolio and product road map presentations are created and maintained manually by Excel and PowerPoint applications even common tools such as PDM, Configurator and ERP and the data inside them could be utilized better, product portfolio revenue data is grouped by certain global invoicing codes under the structure of business lines which makes product profitability analysis difficult
C	overall main business processes have not been described yet
D	no company specific challenges – only common challenges
D	no company specific challenges – only common challenges

Many strategic and tactical tools are available for the evaluation and management of product portfolio in theory. Not many of them have been even identified and only couple of them has been utilized.

3 Portfolio ownership and governance models related challenges in PPM

The definition of ownership is seen to require more clarity as responsibilities and expected activities are not clear. The product portfolio ownership can mean both business and technical responsibilities but many other views as well.

The clarity of product portfolio ownership is seen to be dependent on consistent definitions of product portfolios, product families, applications and platforms. In many case companies there

are no written and formal product portfolio definitions, due to which neither have ownership statements been done. The wider the offered solutions and systems are, more they are seen to cross the borders of possible sub-product portfolios, resulting in more challenges on final ownership, both from sales recognition and technical viewpoints. Offered solutions and systems can consist of many HW, SW and Service products, and can be combinations of all of them.

The ownership and governance of product portfolio management differs based on the size of the company. In the biggest company there is a separate product portfolio management team organized in addition to product managers in separate business units and business lines. In the smallest company, the product portfolio ownerships has been taken by CEO. In medium sized companies the ownership is seen as very collegial and taken by the executive board, or cross functional management team.

Only in one case company there is separate product portfolio management function organized. Even though the team was named a year ago, they still have challenges in applying their role and to get visibility over the entire product portfolio. The similar group of people is currently being created by another interviewed company. This type of group can be created by grouping existing product managers together as a centralized team. In all of the other interviewed companies the ownership is taken by CEO or R&D manager. At the highest level, a group of executives form cross functional and collegial final ownership of product portfolio but even at that level the responsibilities are seen to have room for clarifications. **The overall challenge is to have dedication, time and resources for product portfolio management on needed level of organization.**

Due to lack product portfolio management, or related ambiguities, some key product decisions are seen to be done only at business line / product manager level, or even within customer account teams, without strategic analysis of product suitability to company's product portfolio. More specific challenges face by the case companies related to ownership and governance model are summarized in table 4.

Table 4. Company specific challenges related to product portfolio management ownership and governance models.

A	in practice CEO leads decision making for product decisions, no written and formal ownership statements done**,** product portfolio management would require dedicated time and focus
B	wider the prepared solution is more challenges there are on the final ownership both from sales recognition and technical ownership viewpoints, sales Item level ownership is clear, the definition of ownership requires more clarity as responsibility and expected activities, dedicated and centralized PPM team has been nominated and working but they should have better overview and visibility into product portfolio
C	product ownership topic has not been discussed in company
D	the challenge is the collegial responsibility, no focused and dedicated time and responsibility for active and systematic product portfolio management
D	still some application and platform type of products do not have that clear owners due to missing process and resource gaps both on technology and business side

4 Target setting and key performance indicators (KPIs) related challenges in PPM

The usability of product portfolio management as a concept and a tool for strategy implementation has not been consistently understood and utilized by the case companies. The main reason for this is seen the lack of product portfolio management understanding as a concept.

Most commonly, the product portfolio management targets have been set for the value maximization, such as revenue, sales, cost, investments and profitability targets in the case companies. The financial targets have been set at the company level, and only in few cases at the level of sub-product portfolios. In addition, the case companies are targeting to reduce their product portfolios and to clean-up data. Both of these targets can be connected to the strategic fit of the portfolio. Also, the "state gate" –process related milestone criteria can be seen as strategic targets, and KPIs on individual products and project levels.

The targets for the balance of the portfolio are not recognized by the interviewees.

On the side of key performance indicators the financial measures are the most common. Total sales revenue, cost and profitability at a company level are the most common ones. **The profitability has been measured only at a company level**. In most of the cases this is not even technically possible due to implemented data and reporting structures of the products. Measuring profitability at a company level might be one of the most critical challenges in case companies. The size of the product portfolios have been mainly measured such as number of sales items and

certain other specific types of items. The strategic fit and the balance of the portfolio have been not measured at all. More specific challenges related to product portfolio management target setting and key performance indicators are summarized in table 5.

Table 5. Company specific challenges related to portfolio management target setting and key performance indicators.

A	target setting and KPIs in relation to PPM exist on the area of financial measures only
B	system level solution as combination of many products from several business units creates additional challenges for target setting and use of KPIs, usage of few global invoicing codes creates additional challenges to identification of real profitability of final solutions, sub portfolios and products
C	the tracking of both sales and cost could be done on product level but not practiced yet, the revenue forecasting methods are not in place and possible future sales can be only mirrored back
D	lack of more strategic evaluation of potential new customers and their strategic fit to company's business model and capabilities
D	lack of strategic product portfolio management target setting and KPIs in relation to company's new strategy

5 PPM challenges related to data availability

The data targets for product portfolio management have not been specified thoroughly by the case companies due to overall lack of product portfolio management as a concept. The product portfolio management as dynamic executive level analysis and decision making process is seen to require data availability and reporting from many angles.

The data challenges identified by the case companies are very generic related to the availability of product master data such as bill of material, item codes in different data structures, product compatibility and configuration rules, list of sales items, products and header level systems and solutions.

The data availability, directly from design tools, product data management tools, ERP tools and sales configurators have been not utilized by managers directly. The reporting capabilities of the tools are seen not to be most flexible, and usage of them is seen to require special competences. Instead of using the data from operative tools, the portfolio management related data has been created manually and presented by universal office applications by management. The smaller the company is the better competence the management has to use operative data systems. **Overall the data availability for the use of portfolio management is seen to require better**

specifications on data requirements. More specific challenges on data availability are summarized in table 6.

Table 6. Company specific challenges related to data availability

A	data is available only on one product and data structure layer from the ERP tool, the company has major need for product portfolio and product data definition as concept and structure as critical for new ERP-tool configuration and implementation
B	multiple data systems are in place and consolidation of them creates additional challenges for the availability, the information in operational product design tools, product data management tools, sales configurators, ERP tools and services related tools are not consistently utilized in product portfolio management due to lack of competences of using them and partly due to missing reporting capabilities, instead many data files are created manually resulting in reporting errors
C	technically product data is available centrally but reporting capabilities require improvements
D	in principle all needed product data exists but current product coding method makes the data management inefficient, design-, PDM- and ERP- tools exist but the integrations of them are partly manual
D	new modular and platform based product concepts required to be implemented to new ERP tool with limited the amount of product configurations and rules

Preconditions for product portfolio management

Product portfolio management is seen as a generic challenge in case companies. The viewpoints to product portfolio management challenges include: 1) generic challenges, 2) processes and tools, 3) ownership and governance model, 4) target setting and key performance indicators and, 5) data availability.

Due to current level of understanding, and the existence of product portfolio management practices in the case companies the improvement activities may need to be started from the very basics. Preconditions for product portfolio management improvement, derived based on both theory and interviews, can be summarized as follows:

1. **Creation of basic understanding on the idea and concept of product portfolio management.** The very basic training could be given starting from executive board level to get justification and approval for further improvement needs on the topic. The training can be started to unravel the negative impacts and inefficiencies caused by lack of product portfolio management. Tackling the basic questions such as what, how, when and by whom, are seen important for improving product management practices, especially the question why.

2. **Creation of product portfolio management strategic targets and KPIs** based on company strategy. Strategic targets could be classified as a) strategic fit, b) maximized value, c) portfolio balance and, d) portfolio size. Strategic targets can be aligned with overall capabilities of the company. Each strategic target could be divided to measurable sub-targets and key performance indicators.

3. **Creation of strategic product sub-portfolios** to be able to group products according strategic buckets. Sub-portfolios, product families, applications and platforms are formed and created based on agreed criteria and then prioritized. The synergy between product families to be utilized, not only in marketing and sales, but also in technology development and for the benefit of deliver and service processes. The product portfolio renewal and clean-up can be managed based on modular product platforms and data models to gain efficiency in creation and implementation of them.

4. **Creation of product portfolio management ownership and governance models** to manage the entire group of all sub-portfolios and products over the life cycle. New product development, ramp up, maintain, ramp down, warranty and removal phases can form the continuous renewal of product portfolio according strategic and tactical targets. Product portfolio governance models could be organized based on functional responsibilities and/or based on cross functional steering bodies. The difference in product portfolio management and product management to be clearly communicated and implemented. By nomination of dedicated ownership and man power for product portfolio management could improve the focus and speed up the required activities.

5. **Creation of product portfolio management processes and tools** for the dynamic analysis and decision making. Systematic yearly, quarterly, monthly or even weekly management practices could improve the implementation of strategic and tactical targets consistently. By using agreed processes and tools the needed tasks can be done by agreed roles of people in right order, right time and quality. As an enabler the related processes and tools need to be trained and implemented through all sub portfolios and business units under control of product portfolio management.

6. **The data availability** should be developed according needed information for both strategic and tactical management of product portfolios. This requires first the understanding of product portfolio management as a concept, processes and tools but even more as strategic targets and KPIs. The data specification for product portfolio management can be connected to overall product master data specification requirements.

CONCLUSIONS

Product and business evolution from HW orientation to SW products and inclusion of services has been ongoing already for some time. Many companies sell and deliver combined solutions that are a sum of HW, SW products and related services. Offering a wide variety of products complicates a company's product portfolio, potentially resulting in some challenges. Opportunities for additional and new business and turnover may be missed if product portfolio is not actively developed and renewed. The product portfolio renewal and clean-up can be managed based on modular product platforms and data models to gain efficiency in product creation, maintenance and removal phases. Ideally product portfolio renewal happens in balance of new product introductions and old products removals and by synchronized combination of them. This study analyzes the current product portfolio management related challenges faced by companies.

The challenges related to the product portfolio management were identified in practice. The portfolio management is a generic challenge in case companies regardless the size, maturity and history of the case companies. The challenges start from the disconnection between company strategy and expected product portfolio management strategic targets and follow up. The overall idea and the role of PPM as a higher level analysis and decision making process for product portfolio renewal is not thoroughly understood. The usability of product portfolio management as a concept and a tool for strategy implementation is not consistently implemented while only a couple of strategic and tactical product portfolio management tools are utilized by the case companies. The profitability is measured only at a company level due to current data and reporting structures. The entire product portfolio and sub-portfolios are not clearly defined. Lack of product portfolio level business case thinking can be seen as growing size and proliferation of the product portfolio and as product cannibalization. Product portfolio management processes are not described and documented in case companies. The definition of product portfolio management ownership is seen to require more clarity. The governance models of product portfolio management are not structured and implemented formally over entire product portfolio. The overall challenge is to have focus and time by dedicated resources for product portfolio management on needed levels of organization. The data targets and data specifications for product portfolio management have not been defined thoroughly by the case companies.

The preconditions for implementing product portfolio management practices need to be well connected to the fundamental main challenges. One of the very basic preconditions is to enhance the understanding over the idea and concept of product portfolio management, followed by the creation of product portfolio management strategic targets and KPIs according company strategy. Next preconditions are more operative as creation of strategic product sub-portfolios and related product portfolio management governance models. Dynamic and active product portfolio management processes and tools need to be defined and implemented. Finally the last proposed precondition is the creation of data requirement specification according for the need of portfolio analysis and decision making.

The implications of this study include the potential preconditions of clarifying the role of product portfolio management. The findings can aid business managers in understanding the PPM as an entity that has a role in managing products and portfolios based on strategic and financial targets over product lifecycles.

The limitations of this study include analyzing a limited number of companies. Also, the experience of the analyzed companies varies from only few years to a relatively long history. Regardless of that the portfolio management is seen a generic challenge in case companies.

Several questions were raised up during the analysis which might prove worth further researcher activities, including: a) what are definitions of listed preconditions in more detail for implementing them in practice b) Can product portfolios be visualized to increase the understanding over the entire product portfolio c) How is product portfolio management connected to other business processes, and d) Should product portfolio management be raised to the level of other business processes such as R&D (Product process), Sales, Deliver and Service Processes.

REFERENCES

1. Balachandra, R. (1997), "Factors for success in R&D projects and new product innovation: A contextual framework", IEEE Transactions on Engineering Management, Vol. 44, No. 3, pp. 276-287.

2. Bossidy, L., and Charan, R. (2002), Execution, The discipline of getting things done, Crown Business, New York, New York.

3. Cooper, J. and Griffiths, J. (1994), "Managing Variety in Automotive Logistics With the Rule of Three", International Journal of Logistics Management, Vol. 5, No. 2, pp. 29 –40.

4. Cooper, RG., Edgett, SJ., and Kleinschmidt, EJ. (2001), "Portfolio Management in new product development: Results of an industry practice study", R&D management, Vol, 31, No. 4, pp. 361-380.

5. Cooper, RG., Edgett, SJ., and Kleinschmidt, EJ. (1997)," Portfolio management in new product development: Lessons from the Leaders-I", Research technology management, Vol. 40, No. 5, pp. 16-28.

6. den Hartog, E-J. (2012), "Reducing complexity at Procter & Gamble -complexity approach towards product portfolio management", Master Thesis in Industrial Engineering & Management, University of Twente.

7. Hayes RH, Pisano GP, Upton DM and Wheelwright SC (2005) Operations, Strategy, and Technology: Pursuing the Competitive Edge. John Wiley & Sons, Inc. p.369.

8. Hänninen, K., Kinnunen, T., Haapasalo, H., and Muhos, M. (2012), "Rapid productization challenges and preconditions", International Journal of Product Lifecycle Management. Accepted

9. Jeston, J., and Nelis, J.(2008), Business Process Management. Practical Guidelines to Successful Implementation, Routledge, NewYork, NY.

10. Lynn, G.S., Abel, K.D., Valentine, W.S. and Wright, R.C. (1999),"Key factors in increasing speed to market and improving new products success rates", Industrial Marketing Management, Vol. 28, pp. 319-326.

11. Majava, J., Haapasalo, H., Belt, P., and Mottonen, M. (2012), "Product development drivers in practice", International Journal of Product Development. Submitted for evaluation.

12. Poolton, J., and Barclay, I. (1998), "New product development from past research to future applications", Industrial Marketing Management, Vol. 27, pp.197-212.

13. Randall, T., and Ulrich, K. (2001), Product variety, supply chain structure, and firm performance: analysis of the US bicycle industry, Management Science, Vol. 47, No. 12, pp. 1588–1604.

14. Rummler, G.A., and Brache, A. P. (1990), Improving Performance. How to manage the white space on the organization chart. Jossey-Bass Inc., Publishers, San Francisco, California.

15. Saaksvuori, A. (2011), "PLM vision 2016 and beyond", Sirrus Capital Ltd, Helsinki, Finland.

16. Salvador, F., Forza, C., and Rungtusanatham, M. (2002), "Modularity, product variety, production volume, and component sourcing: theorizing beyond generic prescriptions", Journal of Operations Management, Vol. 20, No. 5, pp. 549-575.

17. Slack, N., Brandon-Jones, A., and Betts, A. (2012), Operations and Process Management. Principles and Practices for Strategic Impact, Pearson Education Limited, Harlow, England.

18. Thonemann, U.W. & Bradley, J.R. (2002). The effect of product variety on supply-chain performance. European Journal of Operational Research, Vol. 143, No. 3, pp. 548–569.

19. Vähäniitty, J. (2006), "Do small software companies need portfolio management?", Licenciate thesis, Helsinki University of Technology, Department of computer science and engineering.

20. Wan, X., Evers, P.T. & Dresner, M.E. (2012). Too much of a good thing: The impact of product variety on operations and sales performance. Journal of Operations Management ,Vol. 30, No. 4, pp. 316–324.

21. Ward, J., and Peppard, J. (2002), Strategic planning for information systems, 3rd ed. Chichester, John Wiley & Sons Ltd.

22. Ward, J., Zhang, B., Jain, S., Fry, C., Olavson, T., Mishal, H., Amaral, J., Beyer, D., Brect, A., Cargille, B., Chadinha, R., Chou, K., DeNyse, G., Feng, Q., Padovani, C., Raj, S., Sunderbruch, K., Tarjan, R., Venkatraman, K., Woods, J., and Zhou, J. (2010), HP transforms product portfolio management with operations research, Interfaces, Vol. 40, No. 1, pp. 17-32.

23. Womack, J., and Jones, D. (1996), Lean thinking. Banish waste and create wealth in your corporation, Simon & Schuster, New York, NY.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

SURNAME AS A LUXURY BRAND: BRAND VALUE PERSPECTIVE

Barbara Mróz-Gorgoń, Ph.D., Wrocław University of Economics, Faculty of Economics Sciences, Institute of Marketing, Department of Fundamentals of Marketing, Assistant professor, ul. Komandorska 118/120, 53-345 Wrocław, Poland
barbara.mroz-gorgon@ue.wroc.pl

BIOGRAPHY

Arts brand passionate
doctors' degree in economics

Areas of research: non-profit arts organizations marketing, culture and art brand image creation
Since 2012 **assistant professor** at the Department of Marketing Fundamentals of the Institute of Marketing, Wrocław University of Economics;
2006-2012 **assistant lecturer**, Department of International Economic Relations

Scientific activity:
To date 17 scholarly papers (including articles in academic journals and monograph chapters) devoted mostly to the problems of franchising development in Poland;
To date Participation in 13 conferences (including presenting papers at 5 conferences, among which 6 were international)

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

SURNAME AS A LUXURY BRAND: BRAND VALUE PERSPECTIVE

Barbara Mróz-Gorgoń, Institute of Marketing, Department of Fundamentals of Marketing, Faculty of Economics Sciences, Wrocław University of Economics, Poland
Email: barbara.mroz-gorgon@ue.wroc.pl

ABSTRACT

Purpose *- This article deals with a type of luxury fashion brand whose name is at the same time the famous surname. The author's views are based on the analysis of the examples excerpted from fashion market.*

Apart from the benefits in the form of a known brand "name" and no necessity to involve great expenditure on promoting the name, the use of a form of a famous artists' surname as a brand can bring the brand managing companies some problems. In case of luxury brands, managers have to face up for instance, to the problem of market segmentation and target group selection. In case of using a famous surname, strictly connected with the world of fashion, determining the target group of consumers to which the market offer will be addressed is a task requiring more subtlety than in the case of other brands.

The purpose of this article is to show the possibilities of making use of famous surnames as luxury fashion brands of products as well as to attempt to verify the thesis put forward by the author that the use of this type of branding and an appropriate marketing strategy can be an excellent form of promoting a given country and culture.

Design/methodology/approach *- The conclusions presented in the paper are based on the literature review, a case study and the results of the author's own research of primary character (sample of 80 respondents) whose aims was to attempt to identify the recognisability of the brands under analysis and to connect their images with the country of origin of a given artist in consumers' consciousness.*

Findings *- The thesis presented in the beginning of the article was confirmed, that the use of this type of branding and an appropriate marketing strategy can be an excellent form of promoting a given country and culture. Both brands (however Kenzo in lesser degree, what results from lower recognition of the brand itself) are respectively associated with culture and Italian and Japanese motives, whereas Versace brand was defined as the one reflecting the Italian climate.*

Originality/value *- Most of researches focus on one instrument of the marketing-mix in that area , that is the promotion of the luxury, fashion brands, their advertising campaign, value of the brand and only few researchers deals with the issue of their business activity. In the literature, one can hardly find the research focusing on the creation of fashion brand identity, by using surname as a brand, which is a very often concept in the fashion and design world, and other elements, such as characteristic national motifs. Most of the authors describe the origin of the brand and its evolution. The study shows , on the examples of Kenzo and*

Versace, that there is a possibility of creating the fashion brand and its identity through the consequent marketing strategy, by using the surname of the designers and traditional, for the specific culture, values and elements.

Keywords: brand, strategy, brand image, brand identity, promotion, design
Classification: Viewpoint

INTRODUCTION

Apart from the benefits in the form of a known brand "name", the use of a form of a famous artists' surname, such as Kenzo and Versace, as a brand can bring the brand managing companies problems too. First of all, while the designers are just at the beginning of the career path, it takes time to become recognizable and then- famous (not always). To be able to counteract problems the company should, like every other firm, gain the specific information about the market, the consumers needs and their preferences but in that case- using the surname as a fashion brand, such as Kenzo and Versace, it's very important to pitch the company offer (4P) to the brand "name" exquisite.

Brand

"Brand" is a very wide concept and the number of the definitions of "brand" which can be found in literature best reflects this complexity. Nowadays, not only the brand researchers attempt to define this term; this concept is often invoked both in specialised – marketing and commerce – literature as well as in everyday life, in which it seems to have become an essential part of every consumer's dictionary all over the world – irrespective of latitude. As a result of such popularisation, this term is intuitively used by the majority of purchasers. In spite of no specialised knowledge, consumers can instinctively specify what the brand actually is.

Along with the progress of civilisation and the more and more changing environment conditions as well as with the increase in purchasers' needs, the term "brand" has been evolving and extended. The brand is a name, a symbol, a pattern or a combination of these elements. It is given by sellers or their group in order to identify goods or services as well as to distinguish them against a background of competitive products. (…) The brand thus identifies the product as well as its manufacturer or deliverer (Kotler &Armstrong&Saunders, Wong 2002, p. 626).

Generally speaking, the brand is a unique unit. It is a kind of a shortcut, by means of which people asses how a given company works, what it produces, offers and sells. A well designed and developed brand is a dynamic image in the customers' minds. (…) Therefore, a powerful brand creates for itself a kind of quasi-monopoly (Barlow& Stewart 2010, p.16).
The brand can also be defined as a product which provides functional benefits plus the added values which certain consumers value to a sufficient extent in order to make a purchase"(Jones 1986:16[in]: Altkorn 2001, p.12) or as a product which has certain features which allow to distinguish it from other products of the same category – that is – the products which fulfil the same need; these differences can be real or symbolic (Keller, 1998, p. 4).

The brand is a name and symbol associated with a known and trustworthy experience which gets both into the head and into the heart (Taylor , 2010, p.95). It is developed in order to precisely identify the product and distinguish from the competitors' offer (Mruk, 2002,p.15).

Taking into consideration the above-quoted definitions, we can notice that they are different from one another in terms of their notional scope and that they show several approaches to the brand. Some of them present the brand in broader terms whereas others narrow down the scope of its meaning. The brand is most often treated as a characteristic aspect of a product and its important, if not the most important, element of the competitive advantage. Such identification in consumers' awareness (product diversity) is, next to cost leadership, the strategy of achieving the competitive advantage. It is worth noticing that many scholars suggest the differentiation strategy with reference to the products which are prone to differentiation (so they are heterogeneous) whereas the cost leadership strategy occurs most frequently in the case of homogenous goods so this concerns such goods which have a slight chance of differentiation or there is no such possibility at all (the so-called the *commodity* strategy). However, the market reality shows that even the homogenous products have the possibility of existing in consumers' minds as one of their kind and of winning the competitive fight and it all is thanks to the creation of a unique brand. "Constructing a brand involves many elements, which together make a comprehensive impression: the product itself, the label on the packaging and the exposition, product name, the manner in which the profits of purchasing the products are presented as well as advertising and promotion. The brand encompasses physical features (smell and taste), aesthetic features (look), rational elements (the ratio of quality to price, utility) and emotional elements (Moi, 2009, p.55).

Brand awareness is the purchaser's ability to recognise to which category of products a given brand belongs as well as the purchaser's ability to recognise the brand. We distinguish two types of brand awareness: spontaneous awareness (*brand recall, spontaneous brand awareness, unaided brand awareness)* and supported awareness (*brand recognition*). Spontaneous awareness informs what percentage of the respondents of a given population spontaneously listed the brand X, when asked about a given product category (Kozielski, 2004, p.260). The modern process of creating brand awareness which we know is the art of instilling and communicating the company's or organisation's values and character through connecting with its logo. Psychology calls it a symbolic connection and regards it as the fundamental learning process. Creating brand awareness is an art, the rules of which change at a fast pace therefore what is recommended is its constant development and openness to widening, deepening or sometimes even changing the line of thought in this respect.

Considering the essence of the brand, it seems vital to refer to other key terms connected with the brand. These are – brand identity and brand image. "Brand identity means the vision of the potential reception of the brand by the customer, or – to put it differently – the desired way of perceiving the brand, created by brand sponsor. It could also be defined as a certain comprehensive message about the brand, sent by the seller to the potential receivers by means of all marketing instruments (Altkorn, 2001, p. 39). Thus, it is a certain emphasised otherness of a given brand, the image of its uniqueness which proves its value. "The task of identity is to define brand importance, intention and vocation" (Kall, 2001, p.25). The defined brand identity established the direction of brand management over time. It is worth stressing that "the marketing name constitutes the most important distinguishing mark which – at the same – co-creates the product brand. It is also the main element of the widely understood brand

identity (*corporate identity, CI*) (Zboralski, 2000, p.38). As claimed by M. Géraldine (Géraldine, 2009,p.52), identity materialises itself only when the whole organisation puts it into action.

Brand image is the collection of feelings connected with brand recognition by its purchasers. In the literature on this topic, we may find the opinions, according to which brand image is a peculiar mental reflection, or even the entirety of the associations with the brand which let distinguish it from analogous products. And although, as stated by J. Altkorn (Altkorn, 2001,p.38), the analogies are most frequently referred to the functional features, this is not appropriate. The associations and convictions connected with the brand pertain to not only the material but also virtual features. Such notions as the "elegant", "traditional", "Swiss" brands, apart from the material benefits and attributes, also involve the whole set of relatively permanent ideas about social as well as mental values which are associated with its use. Brand image is the consequence and result of its reception and of consumer's awareness identity. The father of advertising, Earnest Elmo Calkins (1868-1964), was the first to suggest that the ideals of product purchasers are included in the products. They reflect the aspirations of particular people, their families and social positions (Barlow &Stewart ,2010,p. 38).

One of the most essential components of the brand is its name which may be pronounced, involves letters, digits, words and their combinations. For products and companies, it is like names and surnames for people. It allows consumers to identify and compare the offers of given sellers, considering them worse, better or simply similar to others (Barlow &Stewart, 2010,p. 38). The visual elements of a brand are symbols, trademarks written in a specific way, with the use of specified colours or a specific font(Mruk &Rutkowski, 1999,p.61). Marks, colours as well as fonts and their size can have an enormous influence on the way of brand reception and selected properly, they can enhance the effect of the brand message and make the impression of uniqueness on consumers and therefore become remembered forever. The symbol, the visual element of the brand, is constituted by three key elements:

- typography, so the typeface (logotype),
- graphic elements,
- colours.

Just as a nation's flag expresses the distinct identity of a country, so, too, a logo, helps to establish the name and define the character of a corporation. Effective logos become synonymous with the organizations they portray. They are instantly recognized by millions of people, and help to identify their companies and convey a message about the brands for which they stand (dinesh.com, 2013).

Clothing brands are a status symbol today. Most clothing companies such as Prada, Chanel, Versace, Kenzo, etc make the most of putting their logos on any clothing item that they make.

The next vital element which is sometimes referred to in the definitions of the brand is "product". The product is all that can be offered in the market in order to fulfil some need (Kotler, 2005,p.409). Having in mind the hierarchy of needs described by Maslow, especially in the context of brands known world-wide, we can pose one question about which needs are satisfied by the very product and which by a given brand? It is obvious that the need of attiring with clothes can be fulfilled by each clothing selected appropriately for weather

conditions but not each clothing will provide people with such feeling or prestige and uniqueness as are given by the attire by Prada.

In the hierarchy of product identification, we can distinguish the following four basic elements: colour, form, name and number. However, it is just the name that is an especially important element because – especially in the era of the Internet – what has no name by and large does not exist and is not noticed by consumers. Today, in the world of global market and the idea of "born global" which motivates the creation of a forming company's strategy, managers cannot take the liberty of using ill-considered nomenclature. The name should be clear in each language and easy to pronounce.

The use of a surname

Among all the elements of effective symbolism (used during brand construction), there is a parameter which belongs to the most important ones in brand construction: the surname which is a brand itself. Deciding about the adoption of such a specific brand name, the managers of a given company have to make a decision about the way of its graphic representation. There are two possibilities: either in the form of an individual logotype created on the basis of one of the existing typographies – here a good example in Chanel, Kenzo and Versace brand or as a totally individual stylised signature suggesting its authenticity: Guerlain and Cardin.

Irrespective of the fact that the surname used will function in the logotype or signature, they have the advantage over the non-surname brands in the fact that they directly point to a certain set of values comprising their reputation: tradition, know-how, genius's vision, charisma and frequently also the face – the parameter which is extremely significant in the case of endorsing, for example, the cosmetic products (the signatures of Sabatini, Campbell are a good case in point). In the case of the surname brands, the context of a given person's individual contribution to the creation of a brand moves to the first place – at least in the first phase of brand life. From the moment of acquiring the surname by banks, funds, stock exchange investors etc., the time of the surname is numbered. It starts to be perceived definitely more like an institution than a person; as a company and not as a human being. What is noteworthy is the fact that it is easier to identify a brand with a person and this unique "aureole" comprising this person's personality than to create this aureole around a new name and brand. Provided the company takes care of the products it offers, in creating the brand strategy, it is just a well selected surname that can be a guarantee of an excellent standard.

There are many strategies and ways of positioning the brand in a market. However, not all of them are suitable to be used in the global market. In the literature on this topic, the scholars list from seven to ten strategies (ways) of brand positioning. The brand can be positioned with reference to a famous personality (a star) from the world of sports, culture, politics or entertainment. Such person is then called a brand ambassador. It is assumed that the features and opinions of this person will be transferred onto the brand. In view of the above, what is of crucial importance is the appropriate selection of the candidate for the ambassador, especially on an international scale. This person, most of all, has to be commonly known and bring about positive associations. The most frequent figures used for this purpose are athletes (e.g. . Jordan, Z. Zidane, D. Beckham), models (C. Schiffer, N. Campbell), singers (C. Dion,

Madonna). The risk here is connected with the fact that when the selected person loses his/her reputation for different reasons, then the negative associations also become connected with the brand. What is more, the careers of starts, especially of athletes and models (with only a few exceptions), do not last too long therefore such strategy will not provide long-lasting effects (Szwajca, 2009, pp.51-52). In the case of historical figures such as Chanel and Dior such risk is absent. These figures are the icons of high culture, they were outstanding artists and therefore their surnames constitute brands themselves and can successfully accompany the highly emotional (i.e. *high-touch*) products.

The products of both brands Kenzo and Versace use symbols of culture of their creators, however it's their genius that gives them a new form and as an interpretation of these traditional symbols, they are today associated with the names of two greatest designers.

Kenzo Brand

The House of KENZO was founded in Paris in 1970 by Takada Kenzo. Kenzo, a native of Himeiji, Japan, attended Tokyo's prestigious Bunka Fashion College as one of its first male students before making the move from Tokyo to Paris, where he opened his first boutique, "Jungle Jap." He surprised the fashion world with his originality and the apparent celebration of diverse cultures, nature and colors in his designs.

Bold stripes, swirling, chintzy florals, geometric patterns and folkloric scenes were Takada's signatures, blended together in pieces inspired by his native Japan, the American Mid-West and South American art (Walker, 2013). "Jap wrap" become his moniker.

Following his success in the 1970s, he launched a series of new collections for men, women and children. Since 1988, KENZO PARFUMS has been the creator of some of the most groundbreaking fragrances of the past decades.

In 1993, the KENZO brand joined the LVMH (Moet Hennessy Louis Vuitton) company.

In 1999, Takada Kenzo decided to leave the artistic direction of the KENZO brand and set out on a new journey in life. This year also celebrated Kenzo's 30th anniversary in the industry. The year 2000 marked the birth of FlowerbyKenzo, a fragrance that invented the scent of the poppy, and quickly became a classic in the perfume world. Since then KENZO PARFUMS continues to express the original values of the brand: attachment to nature, poetry, mixing of East and West and a playful marriage of contrasts. These elements along with the vagabond spirit of the brand are present in all forms of KENZO PARFUMS, from its magnificent installations of poppy fields around the world, to its faithful dedication to every detail of a fragrance creation.

In 2001, a skincare line, KENZOKI, was launched. Built around four Asian plants (Rice Steam, Ginger Flower, Bamboo Leaf and White Lotus), the range brought a new approach to skincare; a marriage of pleasure and efficiency (Kenzousa.com, 2013).

As a vision and mission statement the company declares, that "KENZO has always worked towards a multicultural world, a world of colours and beauty, with nature as a vibrant, inexhaustible source of inspiration. Classic, contemporary, or visionary, the women's and

men's perfumes Kenzo created are based on values of life, energy, and a deep-rooted equilibrium" .

Kenzo designs are strictly connected with the elements of Japanese culture. The example of such connection is captured in the bottle of perfume called *Flower by Kenzo* which resembles the shape of a Samurai sword – *Wakizashi.*

The image of Kenzo is developed very solicitously. Apart from the mentioned design, the logotype and pictures used by the brand in the communication process with customers, maintain a consistent character. The logotype which at the same time constitutes the surname of the brand creator, resembles the sign of the Japanese alphabet, as an usual font is applied. When reading the history of Kenzo brand which is available on the Kenzo website, the reader will notice that the text is decorated with artistic pictures of Japanese flowers, whereas a great number of advertisements present variations of Japanese kimonos.

Everything created by Takada Kenzo, coherent brand concept and its message attract the best specialists who want to work for this world-known brand. Carol Lim and Humberto Leon stated in the interview for "The Independent" magazine: "We were offered the opportunity to work on a number of different projects, but the Kenzo brand was the most attractive to us. Not only due to us being long-time fans, but because we wanted to participate in the storytelling of the brand to a whole new generation" (Walker, 2013).

Versace brand

The history of Versace started with the vision of one man in Italy and became a family affair. Gianni Versace SpA, usually referred to as just Versace, is a family owned fashion house headquartered in Milan. Gianni Versace started the company in 1978 with the help of his older brother Santo and his younger sister Donatella.

Gianni Versace was born on December 2, 1946, in Reggio di Calabria, Italy. He began designing clothes at the age of 22 when a local garment maker hired him to design a collection. At the age of 26, he moved to Milan to begin a career in fashion. The first Versace signature collection was premiered in March of 1978 and the first menswear collection was presented in September of the same year. Gianni Versace gained worldwide recognition as an innovative fashion designer (Wagley, 2010).

Versace's illustrious career was decorated with numerous awards, including four L'Occhio d'Oros and an American Fashion Oscar in 1993. Some of his most imaginative creations could be found in theatres; the designer was often applauded for his costume designs for such ballets as Richard Strauss' Josephlegende in 1982, Gustav Mahler's Lieb und Leid in 1983 and Bejart's Chaka Zulu in 1989. In 1987, Versace was awarded with theater's Maschera D'Argento prize (Biography.com, 2013).

Since 1982- the beginning of an ongoing collaboration with La Scala Theatre, Milan, designing costumes for Josephs Legende (Richard Strauss, directed by Pier Luigi Veronesi) Versace's costumes are featured in stage events worldwide (Versace.com, 2013).

On July 15, 1997, 50 year old Versace was murdered in his South Beach home in Miami, Florida.

The explosion of colour, the sharply revealing cuts, and luxurious fabrics that characterized the Versace range were geared to those who wanted to be noticed, to assert their wealth and sexuality, to feel they were at the cutting edge of a rock'n'roll lifestyle. Versace offered customers the promise of standing- out, being noticed, and, almost, wearing a price tag. His designs shouted wealth and status through a megaphone. This ostentation was enhanced by lavish advertising that ensured label recognition and public identification of the style (Gundle, 2008, p.360).

Since Gianni Versace has a strong artistic and literary roots run, and fond of ancient Greek mythology, so he used the Greek mythology, the snake made parthenopipes "Medusa" as a brand trademark.

Legend of Medusa connection with the goddess Athena (Athena) Zhengyan Doo Korea, it was Athena punished her and his head into a monster snake. According to legend, if the eye connects with the Medusa would be turned into stone. In this way, Medusa was later used as a "fatal attraction with a woman" symbol.

Gianni Versace did with Medusa logo, Versace may be a glimpse of the brand style: bright, exaggerated and momentum to force people (Allenlin, 2009).

Versace based the development of his brand on the concept derived from Greek mythology, however his creativity (his brand still pays tribute to these patterns) referred to antic Rome, human infatuation and passion. Versace designs keep the balance between elegance and vulgarity, full of colours and Mediterranean motives, are inseparably bound with the Italian culture. The relationship between Versace and Opera, which originates from Italy, emphasised his Italian style in even more explicit way.

Other marker of and next reference to the Italian culture and tradition, in which the family, home and common feast constitute a priority value, is the line Versace home, whose offer includes the entire variety of decorative elements for home, in particular porcelain collections with Jellyfish and other patterns characteristic for this brand.

Results of own research

In March 2013, the author carried out a ballot research on the sample of 80 respondents. The questionnaire included questions concerning the image of examined brands – Kenzo and Versace. The respondents were the students of different fields of study at Wrocław University of Economics studying within the Erasmus program. These were the representatives of the following countries: Portugal, Spain, Hungary, Germany, Austria, Russia, Belarus and Ukraine, between 21-23 years old. The majority were women (68%), and the men (32%) were the remaining part.

From among the respondents, merely 5% did not recognise the Kenzo brand, 95% agreed that Kenzo is a well-known brand, whereas the Versace brand was estimated by all the respondents as the most famous one.

The majority of respondents, i.e. 60% define the Versace brand as an exclusive brand, whereas the Kenzo brand was defined in the same way by merely 45% of the respondents.

The question concerning emotions expressed by a given brand, 80% of the respondents associated the Versace brand with the feeling of happiness and stated that it is a 'romantic' brand and 'for all age categories of both sexes', whereas as far as Kenzo is concerned, the opinions of the respondents were divided: 40% associate it with the feeling of happiness, whereas for 45% of respondents this brand is perceived as a 'sad' brand. The half of the sample defined Kenzo as a mysterious brand and 35% agreed that this is a brand for young women.

The next part of the questionnaire was connected with the image associated with the country of origin of the brand creators, whose surnames are now the names of the brands.

All respondents knew the country of origin of the Versace brand and stated that the designs with the logo of Versace refer to Italian culture and reflect Italian atmosphere.

In case of Kenzo brand, the result was much more complex. A vast group i.e. 25% of respondents determined that it is an American brand, whereas merely 45% of respondents gave a correct answer (brand of Japanese origin), the remaining part (almost 30%) marked the answer "I don't know".

All questioned respondents were able to recognize the creator of the brand and the 'giver' of the tone of its name - Gianiego Versace, whereas in case of Kenzo brand, merely 25% had such knowledge (the majority admitted that the origin of this brand in unknown – 45%, and 30% marked the answer that Kenzo is the name of a flower).

SUMMARY

As a result of carried out research, it may be stated that the Versace brand is commonly recognisable, whereas the Kenzo brand is less known in Europe.

The reception of these two brands is completely different. Versace is perceived in a very positive way, as a romantic brand, associated with the feeling of happiness, whereas Kenzo brand obtained the byname of a sad and mysterious brand. Transferring the feelings of respondents into the language of music, both brands can be defined in the following way: Versace – brand in major key, Kenzo in minor key.

The majority of respondents defined both brands as exclusive ones, however smaller group of respondents perceives the Kenzo brand in this manner, what reflects the expectations of both brands, as it is encompassed in the description of these two brands.

The aim was also achieved in other case. Both brands (however Kenzo in lesser degree, what results from lower recognition of the brand itself) are respectively associated with culture and Italian and Japanese motives, whereas Versace brand was defined as the one reflecting the Italian climate.

On the basis of the analysis of the examples of two chosen brands and studies of the subject literature and own research, it may be stated that the connection of the creator's surname in the combination of the elements of a given culture emerging as the motives of offered products and fixed and characteristic brand elements, constitute an appropriate combination of the directed message of the brand and they commonly strengthen the associations connected with a given brand.

And that is the hypothesis and the direction for further research, in the future.

The thesis presented in the beginning of the article was confirmed, that the use of this type of *branding* and an appropriate marketing strategy can be an excellent form of promoting a given country and culture.

REFERENCES

1. Allenlin A., (2009) "Versace's brand of fame history", available at: http://www.articlesbase.com/sales-articles/versaces-brand-of-fame-history-1353537.html, (accessed 25 April 2013).
2. Altkorn J.(2001), Strategia marki: PWE, Warszawa , p. 12, p. 38, p. 39
3. Barlow J, Stewart P. (2010), Markowa obsługa klientów. Nowe źródło przewagi nad konkurencją: Oficyna a Wolters Kluwer business, Warszawa, p. 16, p. 38
4. Biography.com, (2013) available at : http://www.biography.com/people/gianni-versace-9517836, (accessed 25 April 2013).
5. Dinesh.com (2013), available at: http://www.dinesh.com/history_of_logos/clothing_logos.html, (accessed 23 April 2013).
6. Géraldine M (2009) , Au coeur de la marque. Les clés du management de la marquee: Wydawnictwo Dunod, Paris, p. 52
7. Gundle S. (2008), "Glamour: a history", Oxford University Press, Oxford, p. 360
8. Kall J. (2001) , Slina marka: PWE, Warszawa , p. 25
9. Keller K.L. (1998), Strategic Brand Management: Prentice Hall, New Jersey, p. 4
10. Kenzousa. com (2013), available at : http://www.kenzousa.com/about-kenzo, (accessed 23 April 2013).
11. Kotler Ph. (2005), Marketing : Wydawnictwo Rebis , p. 409
12. Kotler Ph, & Armstrong G. & Saunders J., & Wong V. (2002), Marketing. Podręcznik europejski: PWE, Warszawa , p. 626
13. Kozielski R. (ed.) (2004),Wskaźniki marketingowe: Oficyna Ekonomiczna, Kraków, p. 260
14. Moi A., (2009), Marketing i Public Relations w małej firmie: wyd. Helion One Press, Gliwice, p. 55
15. Mruk H. (2002), Zarządzanie marką, Wyższa Szkoła Zarządzania i Bankowości w Poznaniu, Poznań, p. 15
16. Mruk H. & Rutkowski I, (1999), Strategia produktu: PWE, Warszawa, p. 61
17. Szwajca D. (2009) „Pozycjonowanie marki na rynku globalnym – możliwości i ograniczenia" [in:] Ekonomia i Zarządzanie , Wyd. Politechnika Białostocka, pp. 51-52
18. Taylor D. (2010) , Wizja marki. Jak zachęcić pracowników do wpływania na rozwój firmy?: Oficyna a Wolters Kluwer business, Warszawa , p. 95
19. Versace.com, (2013), available at: http://www.versace.com/en/history, (accessed 25 April 2013).

20. Wagley A., “History Of Versace”, (2010), available at: http://www.mademan.com/mm/history-versace.html#vply=0, (accessed 25 April 2013).
21. Walker H, “Kenzo: it takes two to make a brand go right” , available at: http://www.independent.co.uk/life-style/fashion/features/kenzo-it-takes-two-to-make-a-brand-go-right-8555526.html , (accessed 24 April 2013).
22. Zboralski M. (2000), Nazwy firm i produktów: PWE, Warszawa 2000, p. 38

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

AN INVESTIGATION OF KEY SUCCESSFUL FACTORS OF BIOTECHNOLOGICAL INDUSTRY PERFORMANCE IN TAIWAN ~ ALSO AN ANALYSIS OF TRADITIONAL CHINESE MEDICINE

Shang-Yung Yen, Professor, Graduate Institute of Management of Technology, Feng Chia University, Taiwan

Shu-Mei Tang, Professor, Department of Financial & Economic Law, Asia University, Taiwan

Wei-Chih Wu, EMBA, Feng Chia University, Taiwan

ABSTRACT

The ever-prospering development of information and communication technology (ICT) in recent years has changed how people conduct communication and their commercial behaviors. A large number of industries, such as semi-conductor and biotech sectors, find themselves in a high-velocity environment, wherein the market demands, peer rivals, and technologies are in a constant change, industrial structure and boundary are becoming blurred and intensively competitive. To survive in such a rapidly changing and highly competitive environment, all industries begin to map out winning strategies as their top priority. Taking biotech industry as an example, and by reviewing of related literature, analysis on the current industrial status, and through analytic hierarchy process (AHP), this paper intends to draw out the key elements that have the most impact on the success of operational performance on biotech industry in Taiwan, and shall conduct further interpretation of the correlation between these elements and the decision-making process. Since the traditional Chinese medicine is a valuable traditional knowledge and has an advantageous position of biotech industry in Taiwan. This paper is also intended to look into the difficult problems and choke points that the TCM met in industries, officials and academic circles in the past, and analyze the present information of them for the purpose of offering these issues with more appropriate suggestions to Taiwan government. In the past years, the learning studies of Chinese medicine have accumulated a number of research results, but such results are unable to be applied effectively to and become one of important industries in Taiwan.

Key words: Traditional Chinese Medicine (TCM), biotechnology industry, patent, intellectual property rights, R&D, Taiwan

INTRODUCTION

Advancement of biotech technology can upgrade our national competiveness, and serves to expand national hi-tech domain, which in turn ensure the continuous growth of the macro-economy. Given the scarcity of natural resources, it is undoubtedly that the development of Taiwan's industries should steer away from those with heavy reliance on energy and of high pollution rates. Therefore, the development of technology- and capital-intensive biotech industry has become an important issue that concerns both the government and the industry.

Since its high-tech-intensiveness, the lengthy developmental time-span, the astronomical R&D cost and high risk involved, plus the large gap in terms of invested resources we have made compared with those of advanced counties, Taiwan's biotech industry are now encountering a host of problems: weak research groundwork, insufficient R&D capability, lacking of global marketing network, and relatively smaller scale, among many others. In facing and overcoming the challenge, Taiwan still has a long road ahead.

A majority of the industry are either small or medium businesses, to which the stickiest problem required to be tackled is operational performance. This leads to the imperative issue of developing effective countermeasures; including (1) Key success elements impacting the operational performance of Taiwan's biotech industry. (2) Impact of human resources has on the operational performance of Taiwan's biotech industry

The manpower and capital involved in biotech industry usually exceed the limited capacity of other domestic industries. Therefore, the key elements for smooth development of the industry lie in the quality management, and R&D talents. In this way, the focus is on the human capital indices: management's capability, employee's capability, corporate cohesion, and the acquiring, cultivating, and recruiting of researchers, developers, and top-grade biotech professionals.

McCarthy E. Jerome divided marketing in his *The Marketing Mix of 4P's Model* into 4Ps: product, price, place, and promotion. He proposed, therefore, that the organization that can identify the best marketing strategy and followed by putting them into action, tends to own more competitiveness than others. Biotech is a cutting-edge technology featuring high

knowledge-intensiveness, technology-intensiveness, lengthy R&D time span, and high risk (Roberts *et al*., 1989). D'Aveni (1994) points out in his *Hyper-Competition* that a world leading industry is the one who has in command of many intangible assets, especially professional knowledge and know-how. In this section, we will discuss several technologic indices, including acquisition and transfer of technology, partnership alliance, and technologic uniqueness.

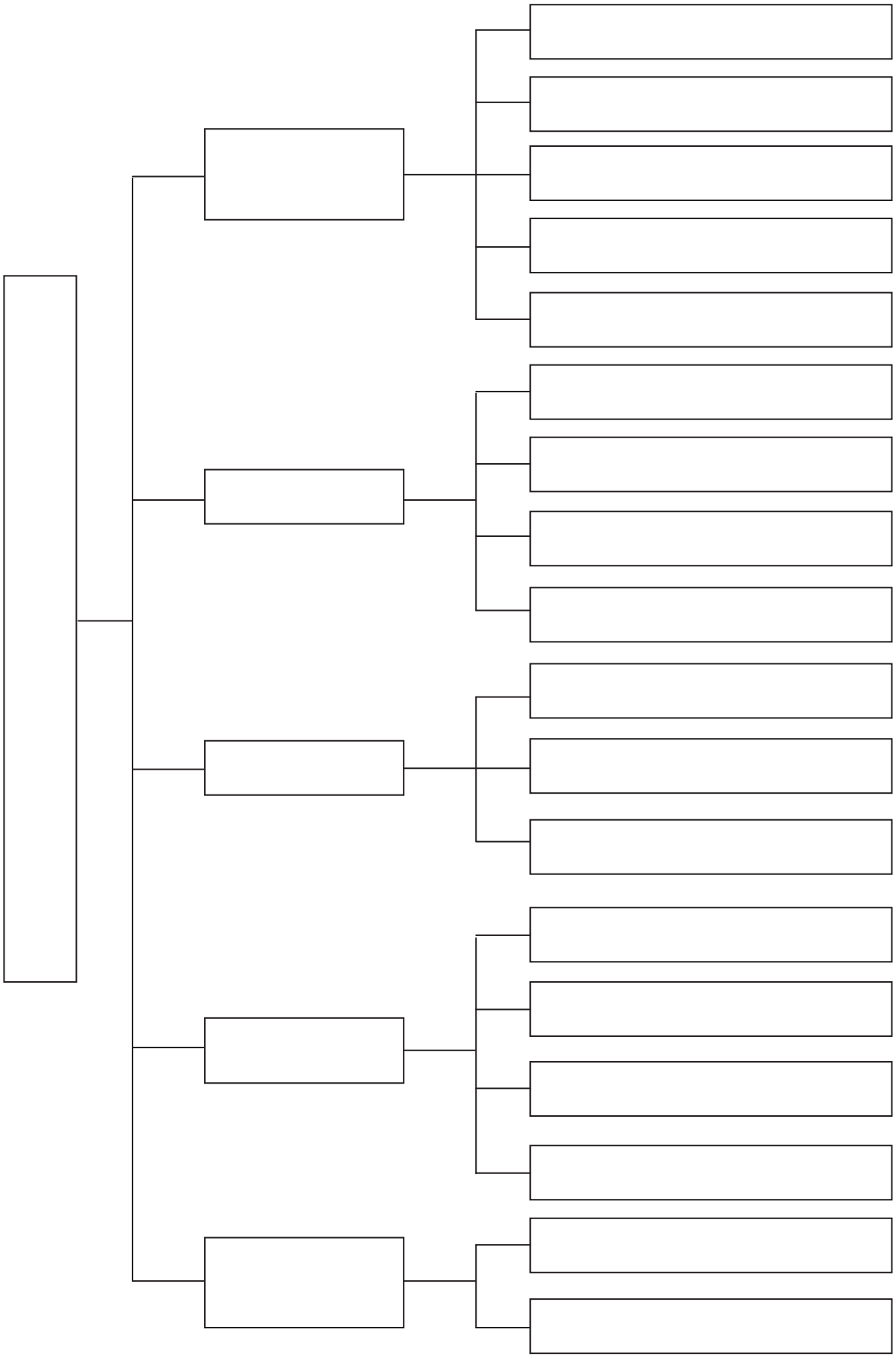
In his *Post-Capitalist Society*, Drucker (1993) argued that innovation is a new ability that can create wealth out of resources, makes resources realize the highest efficiency, and can change the value and satisfaction consumers derive from resources. The purpose of innovation lies in introducing new products, process, and service, to initiative systematic changes in order to increase customer satisfaction and product value. Innovation includes product innovation, new manufacturing process techniques, new structure and management system, and new market development project and management solutions.

In an age of knowledge economy dominance, the economic profits and values created by intangible assets are innumerably tremendous. Governments across the world are putting full efforts in coping with the developmental needs of the industry through providing various subsidiaries and incentives to biotech R&D and innovation, and by amending IPR-related laws and regulations.

RESEARCH DESIGN AND METHODOLOGY

Targeting Taiwan's biotech industry, the present study adopts expert survey to conclude the key success elements. An AHP is used to analyze the returned questionnaires from respondent experts and scholars in the field, and eventually screens out the resultant key success elements.

The present study aims to explore the key success elements of Taiwan's biotech industry. Through reviewing of related literature and industrial analysis, we conclude the major elements, which are then divided into the following three hierarchic tiers as belows:



Sample

The Study group is composed of 45 participants who are representative experts and scholars of biotech industry in Taiwan. They were asked each to complete the questionnaire voluntarily during April-May 2009. 25 of the participants returned completed forms but 3 did not answer properly to the questions. They were later dropped from the analysis so that final study samples are made of 22 individuals.

Analysis results from experts and scholars

(A) Analysis results of success factors

After software analysis, the success factors of framework of this study has shown in table 1 as followings.

Table 1 Analysis results of success factors

KSF	Weight Value	Rank	λMax=5.11 C.I.=0.027 C.R.=0.024<0.1
Human resource factors	0.107	5	
Marketing strategy	0.165	4	
Technical factors	0.2	3	
Innovation Strategy	0.229	2	
Intellectual property rights and patent	0.3	1	

Based on the analysis result, experts and scholars regard IPR and patent rights (with a priority weight of 0.3) have the greatest impact on the operational performance of biotech industry.

(B) Human resources

Table 2 Analysis results of human resource

KSF	Weight Value	Rank	λMax=5.06 C.I.=0.015 C.R.=0.013<0.1
The ability of executives	0.137	5	
The professional competence of staff	0.172	4	
Centripetal force of staff	0.222	3	
R&D personnel's acquisition and cultivate	0.226	2	
Recruiting Outstanding talent	0.242	1	

(c) Marketing strategy

Table 3 Analysis results of marketing strategy

KSF	Weight Value	Rank	λMax=4.02 C.I.=0.005 C.R.=0.006<0.1
Product Strategy	0.289	2	
Pricing strategy	0.211	3	
channel strategy	0.31	1	
Promotional strategy	0.19	4	

Analysis results show that experts and scholars regard channel (with a priority weight of 0.31) has the greatest impact on the operational performance of biotech industry.

(D) Technology

As shown in Table 4 below, technology analysis with software yields the following priority weights:

Table 4

KSF	Weight Value	Rank	λMax=3.00 C.I.=0.002 C.R.=0.004<0.1
Technology acquisition and transfer	0.223	3	
Alliance Partnership	0.253	2	
Technical uniqueness	0.523	1	

Based on the analysis result, experts and scholars regard technologic uniqueness (with a priority weight of 0.523) has the greatest impact on the operational performance of biotech industry.

(E) Innovation strategy

As shown in Table 5, analysis of innovation strategy elements yields the following priority weights.

Table 5

KSF	Weight Value	Rank	λMax=4.01 C.I.=0.004 C.R.=0.004<0.1
Process innovation	0.191	3	
Product Innovation	0.366	1	
Managerial Innovation	0.302	2	
Market innovation	0.141	4	

Analysis results show that experts and scholars have regarded product innovation (with a priority weight of 0.366) as the most influential factor to our biotech industry.

(F) IPR and patent

Results of software analysis of IPR and patent rights show that patent rights (with a priority weight of 0.0667) have the most influential power on the operational performance of biotech industry in table 6

Table 6 Results of software analysis of IPR and patent rights

KSF	Weight Value	Rank	λMax=2.00 C.I.=0.003 C.R.=0.003<0.1
Intellectual property rights	0.333	2	
patent rights	0.667	1	

(G) Overall assessment of the key success elements

Based on the expert survey, we conduct an overall analysis on the AHP framework. Overall analysis and comparison between all priority weights show that patent rights, among all key success elements, is the most influential factor to the biotech industry considered by experts and scholars. These influential factors are shown in table 7.

Table 7 Overall assessment result of the key success elements

KSF for the second layer	Weight Value	KSF for the third layer	Weight Value	Overall Weight Value	Rank
Human resources factors	0.107	The ability of executives	0.137	0.015	18
		The professional competence of staff	0.172	0.018	17
		Centripetal force of staff	0.222	0.024	16
		R&D personnel's acquisition and cultivate	0.226	0.024	15
		Recruiting Outstanding talent	0.242	0.026	14

KSF for the second layer	Weight Value	KSF for the third layer	Weight Value	Overall Weight Value	Rank
Marketing strategy	0.165	Product Strategy	0.289	0.048	8
		Pricing strategy	0.211	0.035	11
		channel strategy	0.31	0.05	6
		Promotional strategy	0.19	0,031	13
Technical factors	0.2	Technology acquisition and transfer	0.223	0.044	9
		Alliance Partnership	0.253	0.051	7
		Technical uniqueness	0.523	0.1	2
Innovation Strategy	0.229	Process innovation	0.191	0.044	10
		Product Innovation	0.366	0.084	4
		Managerial Innovation	0.302	0.069	5
		Market innovation	0.141	0.032	12
Intellectual property rights and patent	0.3	Intellectual property rights	0.099	0.099	3
		patent rights	0.2	0.2	1

Findings of the study show that, regarding the cognition contents of operational performance, IPR and patent rights are the two most important factors considered by biotech experts and scholars, followed by innovation strategy, technology, marketing strategy, and human resources. This indicates the consensus of all experts and scholars that IPR and patent rights are the most important factors to Taiwan's current biotech industry. In addition to the protection provided by IPR and patent rights, it also takes the coordination of good innovation strategy, and well-developed and unique technique to attain a higher goal of operational performance. To reach even higher, the industry will have to strengthen its

marketing strategy and human capitals.

Besides these above survey results, the open questionnaires have resulted in a consensus point of view, that is, traditional Chinese medicine could be a best choice for Taiwan to develop its own industry

The Case of Traditional Chinese Medicine (TCM)

Taiwan is the first country in the world to include Chinese medicine in its national health insurance budget system. In a broad sense, "Chinese herbal drug" is an integrated term for Chinese medicine and herbal medicines that comprise natural ingredients, including various plants, animals, minerals, algae, and/or fungi, or extracts or composites of these ingredients. In Taiwan, no standard requirements that regulate the Chinese herbal drug industry currently exist. Chinese herbal drug manufacturers are generally categorized into three groups: (1) pharmaceutical companies that produce Chinese herbal drugs according to good manufacturing practice (GMP) procedures. The products primarily consist of traditional prescription drugs, including Chinese drugs, concentrated Chinese drugs, and Chinese prescription drugs with new indications or new administration routes. (2) Biotechnology companies that primarily develop new Chinese herbal drugs (including botanical new drugs). (3) Other companies that use Chinese herbal medicines as raw materials for various applications, including in health foods and cosmetics.

Traditional Chinese Medicine (TCM) has a recorded history of at least five thousand years in Chinese society and constitutes a vast treasure of Indigenous knowledge useful for human health, but the protection of intellectual property rights necessary for its scientific development is not adequate due to the nature of TCM. As in Western countries, such as the U.S.A., E.U. countries, Australia, Canada and Eastern countries such as China, Singapore, and Japan, Taiwan's legislation to provide legal protection for intellectual property rights necessary for the scientific development and practice of TCM must be strengthened. Because intellectual property right protection is difficult to extend to Indigenous knowledge such as TCM, efforts must be made to develop new Indigenous knowledge from TCM, both products and procedures, to enable IPR protection. Alternatively, a new legal framework could be developed to encourage the scientific development of TCM which would be protected as Indigenous knowledge. China and Taiwan have a vested interest in seriously pursuing the development of innovative ways to protect intellectual property rights to ensure the on-going scientific development of TCM for the benefit of Chinese companies as well as for the interest of public health world-wide.

The proposed and existing policies and legislation regulating complementary, alternative, and traditional medicine in advanced industrial countries is designed to provide strategies for addressing "…issues of policy, safety, efficacy, quality, access and rational use of traditional, complementary and alternative medicine." Examples include the Guidance for Botanical Drug Products approved by the U.S. FDA in June 2004, the EU Traditional Herbal Medicinal Products Directive of April 2004 which amends the Directive 2001/83/EC and requires all members to promulgate their own national laws regulating TCM by October 2005, the Canadian Natural Health Products Regulations under the authority of the Food and Drugs Act, the Pharmaceutical Administration Law and the 1992 Regulations on the Protection of Traditional Chinese Medicines in the People's Republic of China, and the WHO Traditional Medicine Strategy, 2002-2005. These documents all address the practice and use of traditional, alternative, and complementary medicine (TM/CAM), particularly herbal medicinal products; however, they are not sufficient to provide intellectual property rights to researchers.

Thus, protection of intellectual property rights regarding all aspects of the practice of TCM is an extremely important problem today. Researchers in many countries are applying scientific analysis to traditional Chinese medical practices and herbal remedies in order to ascertain their effectiveness and safety as well as to develop new products and practices. They also aim to develop production methods which guarantee high quality, safe products. Due to the high material and time cost, investors and researchers are reluctant to pursue the development of TCM if they cannot adequately protect their results through trademarks and/or patents. (Brown . 2000)

For a long time, numerous patent applications for Chinese herbal drug products have been submitted, with only a small proportion receiving approval. For patent applications, Chinese herbal drug products are commonly assessed as chemicals. However, Chinese drugs or herbal drugs are generally products based on traditional knowledge that is widely circulated among people; thus, they lack the element of novelty required for patents. According to the Intellectual Property Office, by the end of 2007, 141 Chinese herbal drug patent applications were approved, and the proportion of applications filed by Taiwanese researchers/developers had increased from 50% to 70%. This increase benefits the development of Chinese herbal drugs and biotechnology industries in Taiwan.

CONCLUSION

Because of the high value of knowledge protected by intellectual property rights in the global market, the protection of IPR for research and development of TCM is an important policy issue for the Government of China and Taiwan in term of improving biotech industry. Hence, the Chinese people have a unique opportunity to protect and develop their Indigenous knowledge of TCM for the benefit of all people and at the same time to generate income and recognition for the China and Taiwan as well as for the individual researchers and investors whose intellectual property rights it protects. Thus, it is in the interest of the governments of China and Taiwan to ensure the protection of intellectual property rights in the development of TCM by continuing to innovate in the application of IPR to TCM.

Regarding the key success elements, Daniel (1961) points out in his *Management Information Crisis*, "Most industries usually have 3 to 6 key elements that determine their success." The study selects the top six elements listed in Table 7, and use them as the key success elements. They are, in sequence of order: patent right, technologic uniqueness, IPR, product innovation, market innovation, and channel,

Accordingly, in its pursuit of success, a biotech manufacturer must: (1) establish comprehensive safeguarding measures to protect its IPR and patents; (2) focus on R&D and continuous innovation; (3) conduct innovative reform both on its products and market to gain an competitive edge; and (4) choose the appropriate channels, so that it can promote the development of biotech industry, emulate the standards of advanced countries, and synchronize with the world's bi-tech development.

REFERENCES

1. Aaker, D. A. (1984). Strategic Market Management. New York：John Wiley & Sons Co, 284.
2. Barnard, C. S. (1976). Farm Planning and Control, 2nd Edition. New York: Camrid-ge Boseman Gleen.
3. Bamberger, I. (1989). Developing Competitive Advantage in Small and Medium-size Firms. Long Range Planning, 22(5).
4. Boseman, G. (1986). The Australian Multinational-Parent and Subsidiary Relationships. Management International Review, 43-51.
5. Brown, R. (1992). Managing the "S" curves of innovation. The Journal of Consumer Marketing, 9(1), 61-72.
6. Boynton, A. C., & Robert, R.W. (1984). An Assessment of Critical Success Factor. Sloan Management Review, Summer 1984, 17-27.
7. Campbell, J. P. (1990). Modeling the performance prediction problem in industrial and

organizational psychology. In unnette, M. D., & Hough, L. M. (Eds.). Handbook of industrial and organizational psychology (2nd Ed.), 1, 687-732.
8. Chacke, G. K. (2000). Technology Management - Applications to Corporate Markets and Military Mission. N.Y. Praeger.
9. Cohen, W. M., & Levinthal, D.A. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. Administrative Science Quarterly, 35(1), 128-152.
10. Commons, J. R. (1974). The Economics of Collective. New York :Macmillan.
11. Daniel, R. D. (1961). Management Information Crisis. Harvard Business Review, 111-121.
12. D'Aveni, R. A. (1994). Hyper-Competition: Managing the Dynamics of Strategic
13. Maneuvering.
14. Day, G. S., & Wensley, R. (1988). Assessing Advantage：A Framework for Diagnosing Competitive Superiority. Journal of Marketing, 52.
15. Drucker, P. F. (1993). Post-Capitalist Society. Oxford: Butterworth Heinemann.
16. Drucker, P. F. (1981). What is business ethics. Across the Board, 16(3), 22-32.
17. Duquette, D. J., & Stowe, A. M. (1993). A performance measurement model for the office of inspector general. Government Accountants, 42(2), 27-50.
18. Dzinkowski, R. (2000). The measurement and management of intellectual capital: an introduction. Management Accounting, 78(2), 32-36.
19. Eccles, R. G., & Pyburn, P. J. (l992). Creating a comprehensive system to measure performance. Management Accounting, 74(4),41-44.
20. Eccles, R. G., & Pyburn, P. J. (l992). Creating a comprehensive system to measure performance. Management Accounting, 74(4), 41-44.
21. Garcia, M. M., & Briz, J. (2000). Innovation in the Spanish food & drink industry. International Food and Agribusiness Management Review, 3(2), 155-176.
22. Glueck, W. F. (1982). Business Policy：Strategy Formation and Management Action. New York：McGraw Hill.
23. Green Chris (1993). Well-Dsigned Performance Measurement is The Strategy Tool for Controlling Your Business Objectives. Manager Canadian, 24-27.
24. Hofer, C. W., & Schendel, D. E. (1985). Strategic Formulation： Analytical Concepts, Boston：Harvard Business School Press.
25. Holt, K. (1988). The Role of the User in Product Innovation. Technovation, 12(5),
26. Hubert, S. (1996). Tacit knowledge: The key to the strategic alignment of intellectual capital. Strategy and Leadership, 24(2), 10-17.
27. Hultink, E. J., & Robben, H. S. J. (1995). Measuring new product success: The difference that time perspective makes. Journal of Product Innovation Management, 12(5), 392-405.
28. Kim, W. C., & Mauborqne, R. (2005). Blue Ocean Strategy: How to Create Uncontested Market Space and Make Copetition Irrelevant. Harvard Business School Press.
29. Kohil, A. K., & Jaworski, B. J. (1990). Market orientation: The construct, research propositions, and managerial implications. Journal of Marketing, 54, 1-18.
30. Kolter, P. (2000). Marketing Management. Prentice-Hall Inc.
31. Kolter, P. (2001). A Framework for Marketing Management. Prentice Hall Inc.
32. Keegan, W. J., & Green, M. C. (1997). Principles of Global Marketing, Simon and Schuster (Asia) Pte Ltd. Prentice-Hall Inc.
33. Levinson, N. S., & M. Asahi (1996). Cross-national alliances and international learning, Organizational Dynamics. 24, 51-63.
34. Lin, M. S. (1996). A study on the selection of international marketing channels by

Taiwan's own-brand manufacturers: The case of the information electronics industry. Graduate School of Technology Management, Jiaotong University, Masters Thesis.
35. Miao-Que Lin , Willie Lin & Chih-Hua Pao (2007). The Effects Of Technology Transfer, Marketing Strategy And Innovation Strategy On The Operating Performance Of The Biotech/Pharmaceutical Industry In Taiwan. International Journal of Electronic Business Management, 5(2), 138-151.
36. Oates, K. (1997). Innovation is everybody's business. Management Services, 41(5), 8-13.
37. Paoul M. Stokes(1982). A Total System Approach to Management Control.
38. Roberts, E.B., & R. Mizouchi (1989). inter-firm Technological Collaboration ： The Case of Japanese Biotechnology. International Journal of Technology Management, 4(1), 43-61.
39. Robbins, S. P. (1994). Management. New Jersey: Prentice, Prentice Hall Inc.
40. Robbins, S. (2001). Organizational Behavior. Upper Saddle River, New Jersey: Prentice-Hall, Inc., 9ed.
41. Rockart, J. F. (1979). Chief Executives Define Their Own Data Needs. Harvard Business Review, May 1979, 81-93.
42. Satty, T. L. (1980). The Analytic Hierarchy Process. New York : McGraw-Hill.
43. Steers, R. M. (1975). Problem in the measurement of organizational effectiveness. Administrative Science Quarterly, 20(12), 549-550.
44. Stewart, T. A. (1994). Your company's most valuable asset ：Intellectual Capital. Fortune, October 3, 28-33.
45. Szilagyi, A. D., & Mare, J. W. (1980). Organizational behavior and performance (2nd ed.). California: Good-Year Publishing Company Inc.
46. Thompson, A., & Strickland, A. J. (1998). Strategic Management Concept and Cases. New York：McGraw Hill.
47. Venkatraman, N., & Ramanujam, V. (1986). Measurement of busi-ness performance on strategy research: A comparison of ap-proach. Academy of Management Review, 11(4), 801-804.
48. Zahedi, F. (1986). The Analytic Hierarchy Process－A Survey of The Method and Its Applications. Interfaces, 96-108.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE EFFECT OF THE MINIMUM WAGE ON THE COMPETITIVENESS OF ECONOMY INTRODUCTION

Anna Krajewska, University of Lodz, Poland, Institute of Economics

Piotr Krajewski, University of Lodz, Poland, Institute of Economics

Katarzyna Piłat, University of Lodz, Poland, Institute of Economics

ABSTRACT

The costs of labour are an important factor affecting competitiveness of economy seen both at the macro- and microeconomic levels. One of the constraints which must be taken into account while examining the costs of labour are existing institutional arrangements, including the level of minimum wage and its relation to average wage.

The neo-classical theory assumes that increase in minimum wage leads to a number of adverse consequences in the economy: increased wages, fall in employment, inflation, and increase in public expenditure. This paper presents the results of empirical studies conducted in various research centres on the influence of minimum wage on the situation in the labour market. Based on the analysis of statistical data on Poland and other European Union countries an attempt is made to determine the impact of minimum wage on the economy.
The main purpose of this paper is to demonstrate that minimum wage affects not only economic aspects of the economy but also plays an important social function and counteracts excessive increase in income disparities. The following data will be used in the paper: variation of statutory minimum wages, minimum wages expressed in purchasing power standards, minimum wage level in relation to average gross and net monthly earnings, an attempt will be made to find correlation between these data and the rate of unemployment, inflation, GDP growth in Poland and the regional level of poverty.

The research can be treated as a contribution to the debate on the direction of changes in minimum wage (increase or decrease minimum wage, differentiate minimum wage across regions and young people or maintain uniform level in the country)

INTRODUCTION

During the economic slowdown the high level of unemployment is one of the fundamental macroeconomic problems. Therefore, it is particularly important to assess the impact of various solutions used in the labour market on the level of unemployment. It is often pointed out that in order to improve the situation on the labour market and increase the competitiveness of the economy it would be advisable to lower the minimum wage, taxes on labour, and unemployment benefits. Reduction in the minimum wage may in fact increase the demand for labour. However, lowering of taxes on wages and unemployment benefits

translates into a decrease in the income replacement ratio, i.e. in the relation of income while being unemployed to income from labour and, consequently may lead to an increase in labour supply. The paper begins with a brief historical overview and shows the essence of the minimum wage in the mainstream economics literature. Then, the authors outline the main conclusions of the study on the impact of the minimum wage on the labour market and income differentiation. Another part of the paper contains statistics on the evolution of the minimum wage and its relation to the average wage in the European Union. The authors made an attempt to assess the impact of the minimum wage on the development of unemployment in the EU by using an econometric model. The final part of the paper contains statistics on the Polish economy. The statistics demonstrate that the minimum wage does not harm the economy, i.e., it does not affect the growth of unemployment and inflation.

HISTORICAL CONTEXT

The minimum wage is the lowest remuneration which employers may legally pay to employees in full-time employment. Therefore, this is not a market category resulting from the demand and supply of labour but a conscious government's decision violating the rules of the labour market. Back in 1778 Adam Smith pointed out that that even "the lowest species of common labourers must everywhere earn at least double their own maintenance, in order that, one with another, they may be enabled to bring up two children" (Smith, 1954). This is an attempt to oppose the selfish tendencies of novice industrialists, well captured by Nina Assordobraj who studied the beginnings of the development of the working class and cited the following statement said by a beginning capitalist…"only the low pay can make the worker work regularly (…) A worker is the more lazy the cheaper is the food and the higher is the wage. The proper operation of a manufactory depends on a cheap worker whose pay is enough only for the necessary food and clothing."(Frieske, 2005).

The minimum wage has quite a long history. It was first introduced in New Zealand in 1894, and two years later in the state of Victoria, Australia (Budnikowski, 2009). This means that some 120 years ago the lowest wage was established for a legally employed worker doing simple tasks. Great Britain was the next country which introduced minimum wage in 1909. Much of the credit goes to Winston Churchill, the then Minister of Trade, who held that "It is a national evil that any class of Her Majesty's subjects should receive less than a living wage in return for their utmost exertions… where you have what we call sweated trades, you have no organisation, no parity of bargaining, the good employer is undercut by the bad and the bad by the worst; the worker, whose whole livelihood depends upon the industry, is undersold by the worker who only takes up the trade as a second string… where these conditions prevail you have not a condition of progress, but a condition of progressive degeneration."(Sloman, 2001). Therefore, the state was to define the minimum wage rates which should be respected by employers in order to reduce competition among employers aimed at reducing costs through reductions in wages, harmful for employees. Wage Councils were established in the UK. They were independent bodies which established fair minimum wage applicable to particular professions. In 1993 the Government abolished the Wage Councils and ceased to define the statutory minimum wage but in 1999 the institution was reactivated.

In the U.S., the minimum wage was introduced in Massachusetts in 1912 and in 1913 it was in force in 15 states although it related only to women and children (Mała encyklopedia ekonomiczna, 1962). From 1938 it came into force around the country. When signing the

minimum wage law President Franklin Roosevelt said, “Except perhaps for the Social Security Act, it is the most far-reaching, far-sighted program for the benefit of workers ever adopted here or in any other country.”, (Kamerschen, 1999). The law established the first nationwide minimum wage rate at 25 cents per hour. Over the following years the rate rose, in 1981 it rose to US$3.35 per hour. Regan administration found that the statutory minimum wage rate led to increase in employment, inflation, and bankruptcies and for several years (to 1988) froze the rate even though the purchasing power of wages has declined during this period by 27%. The Chairman of the U.S. Senate Committee on Labor and Human Resources, Edward M. Kennedy, engaged in a struggle for indexation of the minimum wage and stressed that the low, unchanged for years the minimum rate does not provide the full-time workers with resources to meet the basic needs of their families, while enabling the most ruthless and unscrupulous companies to exploit workers. Senator Kennedy believed that the minimum wage rate should be raised to US$4.65 per hour, and in addition, to avoid similar “errors” in the future, the minimum wage should be restored to half the average national wage. The minimum wage in the U.S. is different in different states. The official federal rate is US$7.25 while in four states it is less (US$6.25) and in 20 states more, (the highest in District of Columbia, US$8.25). President Obama’s proposal is to increase the minimum wage up to US$ 9–9.5 per hour.

The minimum wage was sanctioned by the International Labour Organisation in 1928. The ILO explained that the statutory minimum wage was introduced in order to:

1) Reduce the over-exploitation of workers, especially the uneducated, without professional qualifications
2) Ensure an adequate standard of living of people performing the simplest works, the fight against poverty
3) Eliminate certain forms of unfair competition in the labour market (such as discrimination against women, minors, foreigners), (Konwencje, 1996).

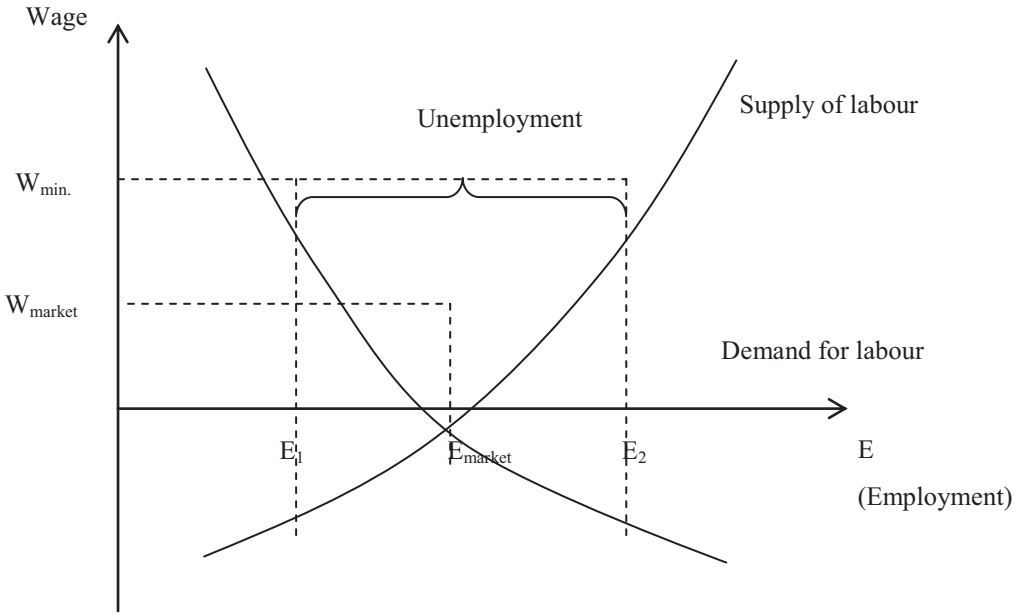
The amount of the minimum wage and its relation to the average wage is the result of collective bargaining involving the Government. The minimum wage can be determined by law or as a result of negotiations. It can be set per hour, per week, or monthly. Individual countries are free to shape the amount and coverage of the minimum wage. In most countries, the nation-wide Act on the minimum wage is in force. In some countries the amount of minimum wage is set by collective bargaining assuming certain differentiation of the amount across budget, profession, and region or employee wage. There are also countries in which negotiations are conducted in a decentralized manner at the level of individual companies.

THE MINIMUM WAGE IN THE THEORY OF ECONOMICS

Classical and neoclassical economics assume that market labour is perfect, i.e., neither companies nor employees can affect the wage level. Wage level and employment size depend on the relation between labour demand and labour supply. The demand for labour curve, as in the case of goods, is downward sloping. Increasing the wages decreases labour demand since it leads to increase in production costs. The supply of labour curve is upward sloping. The higher the salary the greater the number of people willing to work. The point where the demand and supply curves intersect determines the level of wages (W_{market}), at which the labour market is in equilibrium (E_{market}), i.e., there is neither shortage nor surplus of workers on the labour market. Minimum wage set by law (W_{min}) is higher than the market wage.

However, increasing the wages decreases the demand for labour (to E_1 in Figure 1) while the number of people willing to work increases (to E_2). Workers who are employed are gaining because their salaries are rising. At the same time, however, unemployment appears on the market, representing the difference between the demand for labour and the supply of labour (section E_1 E_2).

Figure. 1. Minimum wage on the competitive labour market



Source: Based on: D. Begg, S. Fischer, R. Dornbusch, (1993).

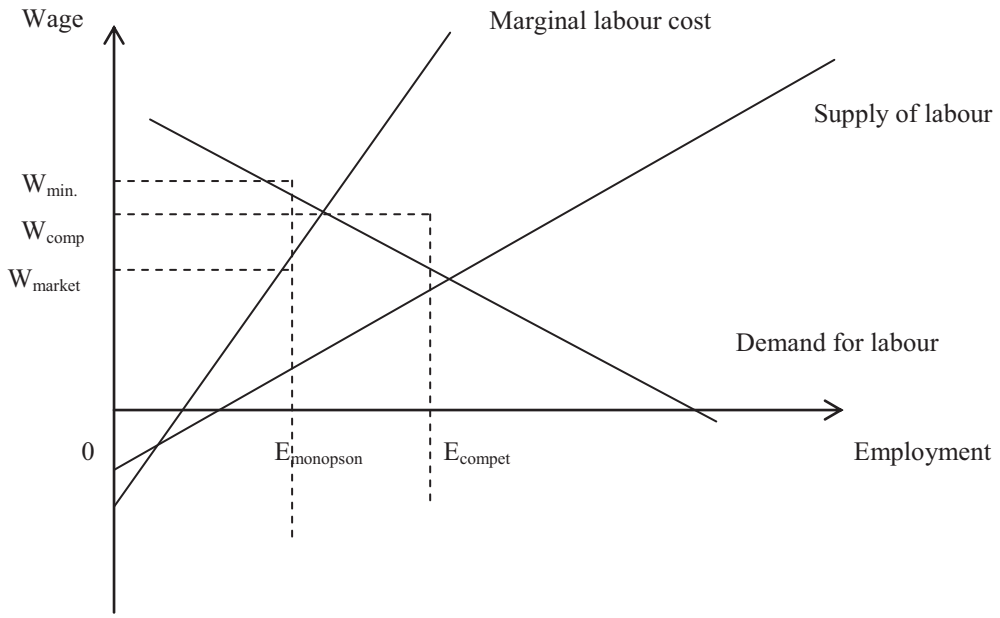
The neoclassical theory assumes that employers and employees do not have full information about the labour market. In such conditions increasing minimum wage prolongs the period of unemployment because the unemployed do not information about different wages in companies resulting from different entrepreneurship.

But the question arises; does the act on minimum wage always lead to increase in unemployment? Figure 1 shows that this will happen because the minimum wage, which is higher than the market wage, leads to a fall in demand for labour. It should be recognized that the labour market is not always fully competitive. Monopsony is an opposition to such market, i.e., it is a situation where a labour market is controlled by an employer who is dominant on the local market, such as steel plant, automobile factory in the city, in which there is no other industry. It may turn out, then, that minimum wage may have a positive effect on the employment.

In a competitive labour market wage is independent of manufacturer. Companies face a horizontal supply curve, which means that they can employ at the current price as many employees as they need. On the other hand, monopsonists face the upward sloping supply of labour curve which means that the more workers they want to employ the more they have to pay them. The increase in wage necessary to attract new employees means that (if companies do not discriminate their employees), they should also increase wages of those already

employed. The cost of hiring an additional worker is therefore higher than the level of wages of those already employed, hence, in Figure 2 the marginal cost of labour curve lies above the labour supply curve. A monopsony maximizing profit will increase employment till the marginal cost of labour equals the value of the marginal product of labour, which is at the same time the demand for labour curve. In a monopsony wage stands at W_{monops} and is lower than employment E_{comp} and wage (W_{comp}) in the competitive labour market. However, if the government sets the minimum wage at a level determined by the point of intersection of marginal cost curve and demand on labour curve this will not reduce the number of workers employed by the monopsony. However, if the government sets the minimum wage at the level that would be attained in a competitive labour market (W_{comp}) this would even increase the number of employed. With wage at the level of W_{comp} (which no longer depends on by how many workers more are employed) because profit maximizing companies increase employment till the moment when demand for labour equals the supply of labour.

Figure 2. Minimum wage in the competitive labour market



Source: Based on D. R. Kamerschen, R. B. McKenzie, C. Nardelli, (1999).

According to Keynes, an increase in the minimum wage does not harm the economy and does not lead to an increase in unemployment. Workers who are getting minimum wage generally have a high propensity to consume. The increase in their remuneration will increase total aggregate demand and therefore will also increase employment.

The minimum wage: A review of empirical studies

One of the main reasons why a minimum wage was introduced was to reduce poverty. A review of the research on the subject, conducted mainly in the U.S. (Burkhauser et al., 1996; Mishel et al, 1995), made by Stanisława Borkowska, shows that: "Aside from the differences in the results, the studies confirm that a large part of the increase in a minimum wage is not aptly addressed and does not contribute to the reduction of poverty. The point is that mainly

the young people receive the minimum wage and their income is not usually the main source of household income (Borkowska, 2005).

Opponents of the law on the minimum wage stress also its adverse social and monetary effects. The increase in the minimum wage makes employers look for a possibility to reduce non-wage components of labour costs. The opponents cite studies conducted in the U.S. The studies were a response to a proposal submitted in the 1980' in Congress to significantly increase the federal minimum wage. The studies suggest that raising the minimum wage is coupled with reduction of training programs (Hashimoto, 1982; Leighton and Mincer, 1981), abandonment of annual bonuses and bonuses for shift work (Wessels, 1980), reduction of social benefits, deterioration of working conditions, reduction of paid leave, and paid sick leave (Alpert, 1983). After analysing the results of various studies Walter Wessels believes that any increase in the minimum wage rate by $ 1 leads to a loss of 20 cents by an employee. He also notes that "The increase in the minimum wage should have resulted in the decrease in voluntary dismissals, but that did not happen. The number of dismissals grows, which means that the employee benefits are reduced in response to an increase in the minimum wage"(Wessels, 1999).

These observations are confirmed by the statistics collected in 2007 by the U.S. Department of Labor (Roth, 2007) which show that:

1) A mere 2.2% of total employment received the minimum wage ($5.85 an hour or about $11,500 per year).
2) Most minimum wage earners were young: more than half (51.2%) of minimum wage workers were between 16 and 24 years old another 21.2% were between 25 and 34.
3) Most minimum wage earners (about two-thirds) worked in food service. Many of these people received supplemental income in the form of tips, which the government did not track.
4) Most minimum wage earners never attended college.
5) Part-time workers are five times more likely to be paid the Federal minimum wage than full-time workers.

The minimum wage draws most criticism regarding its influence on the labour market. The minimum wage results in the fall in demand on labour and increase in unemployment. The extent of unemployment depends on the elasticity of demand for labour –the more elastic the demand curve for labour, the bigger the unemployment. So says the theory, but also the results of many empirical studies, and this affects especially young and low-skilled people. One of the first American studies on this subject demonstrates that an increase in the minimum wage from $1.25 in 1966 to $1.6 in 1972 increased unemployment among teenagers by 3.8% (Ragan, 1977). The negative impact of the minimum wage on unemployment was also confirmed by later studies (Neumark, Wascher, 1997 and 2007; Gunderson, 2005), and OECD reports. Empirical studies on the impact of the minimum wage on the unemployment rate are not, however, unambiguous (Brown, Gilroy, Kohen 1982; Addison, Blackburn, 1999). This may be due to the fact that a mere 1.4% of employees received the Federal minimum wage in the U.S. in 2005.

The Low Pay Commission set up in the UK in order to monitor the effects of the National Minimum Wage has not observed its negative effects. In 2005, the increase in the minimum wage did not have adverse impacts on inflation or employment and in fact the Commission

recommended to uprate the minimum wage even above the growth in the average earnings. A survey conducted among U.K. entrepreneurs in 2004 shows that almost 90% of respondents indicated that the increase in the minimum wage of no importance. In 2005, only 1.8% of all employees received the minimum wage. It is estimated that the re-introduction of the minimum wage in the UK in 1999 had the positive impact on the decrease in Gini coefficient and closing the gender pay gap (Low Pay Commission Report, 2005).

Also studies conducted in Poland assess the impact of the minimum wage on labour market in different ways. The econometric studies conducted by Bogdan Suchecki (1999) covering the years 1990 to 1997 show that the increase in the minimum wage by 10% led to a decline in employment of less than 1% (about 0.76%), but in the case of young workers (15-24 years of age) the same increase in the minimum wage led to a decline in employment of 4.6%. The studies also showed a strong relationship between the increase in the ratio of the minimum wage to the average wage, and the increase in the youth unemployment rate. The increase in this ratio by 1 percentage point is accompanied by a 0.61% increase in the unemployment rate in this group of workers. The findings of another study (Majchrowska and Żółkiewski, 2012) were similar and in addition pointed to the impact of the increase in the minimum wage on the increase in unemployment among low-skilled workers (Kurowska, 2008 and Wojciechowski, 2008).

Different assessment of the minimum wage emerges from a survey conducted in 94 companies representing different sizes and different forms of ownership. The majority of respondents believed that the minimum wage changes have no effect on employment. This also applies to employment of high school and university graduates (Borkowska, 2001). Much the same conclusion can be derived from studies by Zofia Jacukowicz (2007). They show that there is no alternative: low wages or unemployment. There was no correlation between the amount of the minimum wage and the ratio between the minimum wage to the average wage and the averages situation on the labour market in Poland.

The minimum wage in Poland and other countries of the European Union

Currently, the statutory minimum wage is in force in 20 of the 27 European Union countries. In five countries (Austria, Denmark, Finland, Sweden, and Italy), the minimum wage is set at the enterprise level through negotiations between the social partners. In the other two countries of the EU (Germany and Cyprus), the minimum wage is determined separately for individual groups.

The minimum wage denominated in euro is strongly correlated with the level of economic development and GDP per capita. The minimum wage is the highest in Luxembourg, (EUR 1,874 in 2013), and the lowest in Bulgaria and Romania (respectively EUR 158 and EUR 157). Poland (with EUR 377) ranks 12th among the 20 of the EU's 27 members which have national minimum wages. Comparing the level of the minimum wage in 2000 and 2013 (Table 1), it is clear that the differences between the minimum wage in the richest EU countries and Poland have decreased. In 2000, the minimum wage in Poland was 7.3 times lower than in Luxembourg, and in 2013 it was only nearly five times lower. These relations look different when we compare changes in the minimum wage in Poland with countries of Central and Eastern Europe. During the period under study the minimum wage increase rate was in all these countries higher than in Poland. In 2000, in Bulgaria and Romania, the

minimum wage denominated in EUR accounted for only 20% of minimum wage in Poland and in 2013 it rose to 42%.

Table 1. The minimum wage in the European Union in 2000 and 2013

Country	2000			2013			2000 = 100
	Place	In EUR	Poland = 100	Place	In EUR	Poland = 100	
Luxembourg	1	1221	731	1	1874	497	153.5
Netherlands	2	1111	665	3	1469	390	132.2
Belgium	3	1096	656	2	1502	398	137.0
France	4	1083	649	5	1430	379	132.0
Ireland	5	944	565	4	1462	388	154.9
Great Britain	6	936	560	6	1264	335	135.0
Greece	7	540	323	7	863	229	159.8
Malta	8	509	305	10	697	185	136.9
Spain	9	496	297	9	753	200	151.8
Slovenia	10	372	228	8	784	208	210.8
Portugal	11	371	222	11	556	150	152.6
Poland	12	167	100	12	377	100	225.7
Czech Republic	13	126	75	16	312	83	247.6
Lithuania	14	112	67	17	289	77	258.0
Hungary	15	98	59	13	340	90	346.9
Slovakia	16	94	56	14	338	90	359.6
Estonia	17	89	53	15	320	85	359.6
Latvia	18	87	52	18	287	76	329.9
Bulgaria	19	38	23	19	158	42	415.8
Romania	20	34	20	20	157	42	416.8

Based on Eurostat.

Taking into account purchasing power parity the differences in the level of the minimum wage in the EU countries have diminished (Table 2). In Luxembourg, the minimum wage is four times higher than in Poland. The gap between Poland and new Member States is smaller when expressed in purchasing power parity.

Table 2. The minimum wage in the European Union in 2000 and 2013 in EUR by purchasing power parity

Country	2000 r.			2013 r.			2000 = 100
	Place	PPS	Poland = 100	Place	PPS	Poland = 100	
Luxembourg	1	1203	398	1	1524	233	126.7
Netherlands	2	1110	368	2	1358	208	122.3
Belgium	3	1074	356	3	1353	207	126.0
France	4	1023	339	4	1298	198	126.9
Ireland	5	822	272	5	1257	192	152.9
Great Britain	6	809	268	6	1153	176	142.5
Malta	7	708	234	8	895	137	126.4
Greece	8	637	211	10	715	109	112.2
Spain	9	583	193	9	775	119	132.9
Slovenia	10	511	169	7	913	140	178.7
Portugal	11	447	148	12	650	99	145.4
Poland	12	302	100	11	654	100	216.6
Czech Republic	13	263	87	17	425	65	161.6
Lithuania	14	221	73	15	440	67	199.1
Slovakia	15	212	70	14	467	71	220.3
Hungary	16	199	69	13	545	83	273.9
Estonia	17	156	52	18	411	63	274.0
Latvia	18	152	50	16	440	67	199.1
Bulgaria	19	99	33	19	321	49	324.2
Romania	20	83	27	20	274	42	330.1

Based on Eurostat.

The International Labour Organization has adopted, that the minimum wage should represent 50% of the average wage (Convention No. 137 of 1970). This level of the minimum wage was also entered in the European Social Charter. The most similar relations among the EU countries can be found in France (48% in 2011, 49% in certain years) and Slovenia (47%). He lowest relationship between the minimum and average wage persist in Estonia (32%) and Romania (33%), although during the last 12 years (2000–2011) the minimum wages grew in these countries at the fastest rate (from 20% in Romania and 26% in Estonia). It is also worth noting that just before the current crisis (between 2005 and 2007), the relationship between the minimum wage and the average levels declined in many EU countries, which was dictated by the pressure to increase the competitiveness of the economy and reduce labour costs. However, when the crisis started in almost all EU countries, the relation between the minimum wage and average wage has begun to increase (Table 3). These tendencies become more visible when we take median into account.

Table 3. Minimum relative average wages of full-time workers (mean)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Belgium	0.46	0.45	0.45	0.45	0.44	0.44	0.43	0.43	0.44	0.44	0.43	0.43
Czech Republic	0.38	0.37	0.36	0.36	0.36	0.36	0.36	0.36	0.37	0.38	0.39	0.40
Estonia	0.26	0.27	0.28	0.30	0.32	0.31	0.29	0.28	0.32	0.34	0.34	0.32
France	0.45	0.46	0.46	0.47	0.47	0.48	0.49	0.48	0.48	0.49	0.48	0.48
Greece	0.37	0.36	0.36	0.34	0.32	0.32	0.31	0.31	0.33	0.33	0.33	0.35
Hungary	0.28	0.39	0.43	0.37	0.36	0.36	0.36	0.35	0.35	0.35	0.35	0.36
Ireland	0.59	0.44	0.43	0.43	0.45	0.46	0.44	0.45	0.44	0.43	0.44	0.44
Latvia	0.31	0.34	0.32	0.33	0.35	0.31	0.27	0.27	0.30	0.39	0.40	0.43
Lithuania	0.36	0.36	0.36	0.36	0.38	0.37	0.34	0.32	0.32	0.38	0.37	0.36
Luxemburg	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.33	0.34	0.34	0.35
Netherlands	0.45	0.44	0.45	0.44	0.43	0.42	0.42	0.41	0.41	0.41	0.42	0.42
Poland	0.33	0.34	0.34	0.35	0.35	0.34	0.33	0.31	0.34	0.37	0.36	0.36
Portugal	0.35	0.35	0.36	0.36	0.37	0.37	0.35	0.36	0.36	0.37	0.39	0.39
Romania	0.20	0.29	0.29	0.34	0.33	0.31	0.29	0.26	0.30	0.32	0.31	0.33
Slovakia	0.34	0.35	0.34	0.36	0.35	0.35	0.35	0.35	0.34	0.36	0.36	0.36
Slovenia	.	.	.	.	.	0.43	0.43	0.42	0.41	0.40	0.46	0.47
Spain	0.34	0.34	0.33	0.33	0.33	0.35	0.35	0.36	0.35	0.35	0.35	0.35
Great Britain	0.34	0.33	0.35	0.35	0.36	0.37	0.37	0.38	0.38	0.38	0.38	0.38

Source: OECD. Stat Extracts

Table 4. Minimum relative average wages of full-time workers (median)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Belgium	0.53	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.51	0.52	0.51	0.50
Czech	0.32	0.35	0.37	0.37	0.38	0.39	0.40	0.38	0.36	0.36	0.35	0.36
Estonia	0.33	0.33	0.35	0.38	0.40	0.38	0.36	0.34	0.39	0.41	0.41	0.39
France	0.56	0.58	0.58	0.58	0.59	0.60	0.61	0.60	0.60	0.61	0.60	0.60
Greece	0.47	0.46	0.46	0.45	0.44	0.45	0.45	0.46	0.48	0.48	0.49	0.51
Hungary	0.37	0.51	0.57	0.48	0.48	0.48	0.49	0.48	0.48	0.48	0.47	0.50
Ireland	0.68	0.52	0.51	0.51	0.53	0.54	0.52	0.53	0.52	0.50	0.48	0.48
Latvia	0.42	0.46	0.43	0.44	0.48	0.41	0.37	0.36	0.41	0.52	0.54	0.57
Lithuania	0.47	0.46	0.46	0.46	0.48	0.47	0.42	0.40	0.39	0.44	0.45	0.48
Luxemburg	0.41	0.42	0.41	0.42	0.41	0.42	0.41	0.41	0.41	0.41	0.41	0.42
Netherlands	0.51	0.50	0.50	0.50	0.49	0.48	0.47	0.47	0.47	0.47	0.47	0.47
Poland	0.40	0.42	0.42	0.43	0.42	0.41	0.41	0.39	0.42	0.45	0.45	0.45
Portugal	0.49	0.49	0.51	0.51	0.52	0.53	0.51	0.51	0.52	0.54	0.57	0.57
Romania	0.28	0.42	0.42	0.49	0.47	0.45	0.42	0.38	0.42	0.46	0.45	0.48
Slovakia	0.42	0.43	0.42	0.45	0.44	0.43	0.45	0.44	0.43	0.45	0.46	0.46
Slovenia	.	.	.	.	.	0.51	0.51	0.50	0.49	0.49	0.57	0.58
Spain	0.43	0.43	0.42	0.41	0.42	0.44	0.44	0.46	0.44	0.44	0.44	0.44
Great Britain	0.41	0.40	0.43	0.42	0.43	0.45	0.45	0.47	0.46	0.46	0.46	0.47

Source: OECD. Stat Extracts

The impact of the minimum wage on the unemployment rate: The panel analysis

In this section, we have tried to estimate the impact of the minimum wage and the income replacement ratio on the evolution of unemployment in the European Union. In the first place, we present the potential mechanisms of the impact of the minimum wage and the income replacement ratio on the labour market. Then, we examine the evolution of these indicators in Poland compared to other European Union countries and we verify the hypothesis that the value of the minimum wage or the income replacement ratio affects the development of unemployment, including the unemployment rate among people under 25 years of age. Empirical analysis was carried out for the European Union based on panel data from the years 1999 to 2012.

The value of the minimum wage affects mainly the demand-side of the market. The high minimum wage may in particular increase unemployment among people with lower qualifications. This effect may be accompanied by an increase in labour demand for higher-skilled employees or may decrease the overall level of demand for labour.

The income replacement ratio is defined as the ratio of income from various sources of state aid in the situation of job loss, to the income from labour. The income replacement ratio may affect the supply side of the labour market, affecting the motivation to work, or stop working (Strzelecka, 1998). If a sum of all unemployment benefits is only slightly lower than the net pay then a person who receives these benefits may have a little incentive to work. Consequently a high replacement ratio may lead to the so-called unemployment trap.

A potential impact of state regulatory actions concerning the minimum wage and replacement ratio on the development of unemployment has been verified on the basis of an econometric model.

The ratio of the minimum wage to the average wage (Eurostat data) in a particular country was adopted as the variable determining the impact of the minimum wage on the labour market. The income replacement ratio was defined in accordance with Eurostat methodology as a ratio of unemployment benefits paid in the event of becoming unemployed to net wage in the case of a person without children earning two-thirds of an average wage.
Moreover, since there is a correlation between the economic situation and the level of unemployment (see e.g. Martin, 1993; Czyżewski, Łapińska-Sobczak, 2001; Kwiatkowski, Kucharski, Tokarski, 2002), apart from variables related to the state policy, the demand gap was adopted as a variable explaining the development of unemployment rate. The paper is based on estimates of demand gap used by the OECD (2012).

The total unemployment rate (Eurostat data) is the dependent variable in the model.

Model parameters were estimated based on panel data from the years 1999-2012 for the countries of the European Union. Usually, a Fixed Effects Model (FEM), or a Random Effects Model (REM) is most frequently used in panel analysis (see Hayashi, 2000; Hsiao, 2003; Krajewski, Mackiewicz, 2007). As indicated, e.g. by Kennedy, the use of a Fixed Effects Model ignores completely the differentiation of cross-sectional variation. Cross-sectional effects are essential in our model and therefore the use of a Fixed Effects Model seems to be in this case unjustified. For this reason it was decided to use a Random Effects

Model which consists in conducting estimation with generalized least squares method which makes it possible to differentiate variance of the random variable across different countries (see Krajewski, Mackiewicz, 2006).

It was assumed in the model (due to the hysteresis effect in the labour market) that unemployment rate depends on the level of unemployment in the previous period. As a result, the model takes the following form:

$$u_{t,i} = \alpha_0 + \alpha_1 u_{t-1,i} + \alpha_2 \frac{w_{t,i}^{\min}}{\overline{w}_{t,i}} + \alpha_3 \frac{ub_{t,i}}{nw_{t,i}} + \alpha_4 \tilde{y}_{t,i} + \xi_{t,i} \quad ,$$

where:

$u_{t,i}$ -the unemployment rate in the *t* year in the *i* country,

$\frac{w_{t,i}^{\min}}{\overline{w}_{t,i}}$ - ratio of the minimum wage to the average wage in the *t* year in the *i* country,

$\frac{ub_{t,i}}{nw_{t,i}}$ - ratio of unemployment benefits paid to the net pay in the *t* year in the *i* country,

$\tilde{y}_{t,i}$ - the demand gap in the *t* year in the *i* country,

$\xi_{t,i}$ - random variable,

$\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4$ - model parameters.

Based on the estimation of the model parameters the following estimates were obtained:[1]

$$u_{t,i} = \underset{(1,542)}{1,799} + \underset{(28,692)}{0,849} u_{t-1,i} - \underset{(-0,499)}{0,010} \frac{w_{t,i}^{\min}}{\overline{w}_{t,i}} + \underset{(0,147)}{0,001} \frac{ub_{t,i}}{nw_{t,i}} - \underset{(-5,579)}{0,232} \tilde{y}_{t,i} \quad , \quad R^2 = 0,864$$

The estimates show that the demand gap has statistically significant impact on the development of the unemployment rate in the European Union. The increase in the demand gap by 1 percentage point is on the average associated with an about 0.2 percentage point decrease in unemployment rate. Furthermore, the results indicate that unemployment has a strong hysteresis. At the same time the estimates show that neither the minimum wage nor the income replacement ratio does not in a statistically significant way affect the development of the unemployment rate.[2] Therefore there is no reason to reject the hypothesis that the formation of the minimum wage and the income replacement ratio do not affect the development of the unemployment rate.

The high level of the minimum wage or income replacement rate may primarily affect the development of unemployment for those earning less, less skilled, and therefore has greater impact on young people, under 25 years of age. In order to verify whether the minimum wage or income replacement ratio affects the unemployment rate for people under 25 the parameters of the following equation were estimated:

[1] The values of Student's t-tests are given in parentheses.
[2] At all standard levels of significance (i.e. 10%, 5%, and 1%).

$$u_{t,i}^{<25} = \beta_0 + \beta_1 u_{t,i}^{<25} + \beta_2 \frac{w_{t,i}^{\min}}{\overline{w}_{t,i}} + \beta_3 \frac{ub_{t,i}}{nw_{t,i}} + \beta_4 \tilde{y}_{t,i} + \zeta_{t,i} \quad ,$$

where:

$u_{t,i}^{<25}$ - the unemployment rate for people under 25 in the t year in the i country, (Eurostat data),

$\zeta_{t,i}$ - random variable,

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4$ - model parameters.

Therefore, the above equation is the same as equation (1), while the overall unemployment rate was replaced with the unemployment rate for people under 25. As before, a Random Effects Model was applied.

The results of estimation are as follows:

$$u_{t,i}^{<25} = \underset{(2,082)}{5,168} + \underset{(25,706)}{0,840} u_{t,i}^{<25} - \underset{(-0,437)}{0,019} \frac{w_{t,i}^{\min}}{\overline{w}_{t,i}} - \underset{(-0,465)}{0,009} \frac{ub_{t,i}}{nw_{t,i}} - \underset{(-5,267)}{0,470} \tilde{y}_{t,i} \quad , \; R^2 = 0,834$$

The results for the unemployed under 25 are similar to the results for all unemployed. There is also a strong hysteresis effect in the group of young people. Economic fluctuations affect unemployment rate among people under 25 even stronger than in the case of overall unemployment rate. The strong response of the explanatory variable to the changes in demand gap results from the fact that during economic slowdown the employers may in the first place dismiss low-skilled people.

From the point of view of the objectives of this paper the most import ant are the results obtained for parameters β_2 and β_3. As in the case of equation (1), no statistically significant relationship was found between the minimum wage or income replacement ratio, and the development of unemployment rate.

The aim of the study was to test the hypothesis that the minimum wage or income replacement ratio affects the development of unemployment, including the unemployment rate among people under 25. The empirical analysis was performed for the European Union based on the panel data from the years 1999–2012. Based on the estimates it was found that there was no reason to reject the hypothesis that the minimum wage and income replacement ratio do not affect the development of the unemployment rate. What is particularly interesting, the estimates do not indicate that the minimum wage nor income replacement ratio can adversely affect the unemployment rate among people under 25, while both the theoretical premises and many studies have shown that the negative impact of the minimum wage and income replacement ratio on the unemployment among young people should be particularly relevant.

The impact of the minimum wage on Polish economy

The minimum wage in Poland is low. In 2013 it is only € 377 and accounts for 36% of the average wage. So it is no surprise that the unions have been seeking for several years to raise it to 50% of the average wage, but they encountered strong resistance from the government

and employers. The liberal model of economic policy implemented in Poland clearly favours businesses. This is reflected in the reduction of taxes, more and more elastic labour market, low unemployment benefits which are paid for ever shorter time, reduced range of social benefits, tolerance for the large informal sector which makes it possible for employers to evade taxes and employ workers on unfavourable conditions. The attitude of the government, politicians, employers, the media, and many scientists towards the minimum wage is unfavourable.

These are the most often raised arguments of the opponents of the minimum wage, however, not supported by statistics:

1) Raising the minimum wage leads to an increase in unemployment. It should have been taken into account that there is no consensus in this regard, both in theory and research findings. Statistics on Poland show that unemployment is to the most extent correlated with economic fluctuations. The unemployment rate, especially among youth began to fall after Poland's accession to the European Union due to mass economic migrations of young Poles, mainly to the UK and Ireland. However, the global crisis has significantly slowed down this trend (Table 5).
2) Increase in the minimum wage leads to an increase in the average wage in the economy, which in turn produces inflationary wage-price spiral. Such a situation would arise if a wage growth rate was higher than productivity growth rate. Statistics show that GDP and productivity expressed in current prices grew faster than wages. Assuming that 2000 = 100, in 2012 these categories were as follows (Statistical Yearbook 2011, Statistical Bulletin, 2013):
   Gross average wage – 186.0
   Minimum wages – 214.3
   GDP at current prices – 220.4
   Labour productivity measured as GDP per 1 employee - 238.0.
3) The minimum wage and its rate of growth are often the basis both for the indexation of wages in the public sector and certain social benefits, such as unemployment benefits and certain industry-related benefits which results in increase in the fixed budget expenditure, unjustified by economic criteria (Wyżnikiewicz, 2012). These fears have not been confirmed neither by the social policy conducted in Poland nor by statistics. The statistics show that the budget expenditure for social purposes in Poland is systematically decreasing, and it also appears to be at a much lower than in other EU countries. In 2010 the budget expenditure for social purposes accounted for 17% of GDP against 21.6 of GDP in EU-27 (General Government Expenditure by Function, COFOG, and Eurostat).
4) The high minimum wage, considered to be too high by businesses, especially in the conditions of high unemployment and large grey economy, leads to a common practice of paying employees money under the table which furthermore aggravates the grey zone. Employees instead of being employed under the contract of employment work based on the so-called "Junk contracts", (the same duties as under the contract of employment but no rights). The fact that this is happening in Poland on a large scale is not a result of the lack of minimum wage law but because the legal system is weak and inefficient and tax system tolerates such activities, as well as because of the high unemployment, especially among young people and the poor social security system, which forces people to agree on the terms and conditions set by the employer.

5) The minimum wage threatens the existence of businesses; especially micro-businesses which operate on the verge of profitability and raising the minimum wage can lead to bankruptcy. This argument was used both by Michael Howard, the British Employment Secretary, who in 1992 pushed through the abolition of the minimum wage bill, saying, "There can be no conceivable justification for a policy which would, on its own, wreak our economy and devastate job prospects"(Sloman, 2001) and by contemporary Polish economists and even social policy scientists. For example, Bohdan Wyźnikiewicz (2012) believes that the increase in the minimum wage deteriorates conditions for operation of micro-enterprises, especially in small towns, where companies are unable to ensure the minimum wages for low-skilled workers. On the other hand Stanisława Golinowska believes that the minimum wage accounting for 40% of the average wage is relatively too high because "So defined, the minimum wage is a significant barrier to the development of small businesses where most jobs are created." (Golinowska, 2005).

Table 5. GDP growth rate, unemployment rate and the minimum wage

Year	Unemployment rate		The minimum wage in relation to:		GDP growth rate
	Total	Among people under 25	Average wage	Median	
2000	16.1	35.1	0.33	0.40	4.2
2001	18.3	39.5	0.34	0.42	1.1
2002	20.0	42.5	0.34	0.42	1.3
2003	19.8	41.9	0.35	0.43	3.6
2004	19.1	39.6	0.35	0.42	5.3
2005	17.9	36.9	0.34	0.41	3.5
2006	13.9	29.8	0.33	0.41	6.2
2007	9.6	21.6	0.31	0.39	6.8
2008	7.1	17.2	0.34	0.42	5.1
2009	8.1	20.6	0.37	0.45	1.6
2010	9.7	23.7	0.36	0.45	3.9
2011	9.7	25.8	0.36	0.45	4.3
2012	10.1	26.5	.	.	2.0

Source: Eurostat.

It is one-sided and overly simplistic reasoning, which does not coincide well with statistics, which demonstrate that contrary to appearances, businesses are doing very well. This is evidenced by:

1) High profitability of the corporate sector, even in the global crisis. In 2009, the gross profitability rate was 4.9% and a net rate 4.1% and in 2010 these rates even improved to respectively 5.2% and 4.4% (Statistical Yearbook, 2011). The last two years were also favourable in this respect, the gross profitability rate was 5.4% in 2011 and 4.2% in 2012 (Statistical Bulletin, 2013).

2) The decreasing share of employment–related costs in GDP in favour of other factors of production – from 40.2% in 2000 to 37.2% in 2010 as against 56.1% in Denmark and 53.6% in Sweden (Statistical Yearbook, 2011). At the same time, however, the investment growth rate is lower than the growth of GDP. Assuming that the year 2000=100 these figures were in 2010 (at current prices) as follows: GDP - 190.1; investment outlays) - 163.2, of which public investment - 204.0, and private investment - 141.0 (Statistical Yearbook, 2011).In 2011 GDP was 211.1, and investment outlays respectively: 182.7 and 236.1 – public investment, 154.3 private investment (Statistical Bulletin, 2013). Thus, high corporate profits are not fully allocated to the development and creation of new jobs.

This information shows that there reigns in Poland (among businessmen) the logic of cutting labour costs. There is a need for reflection – is it possible to live and think about starting a family with a minimum gross wage of PLN 1600 (€ 377)? One should also think about the economic cost of the decreasing share of labour costs in GDP in favour of other factors of production. And the argument that raising the minimum wage threatens the existence of many small, non-competitive companies can be answered with the words of the general chairman of the Polish Trade Unions and the Vice-President of the Trilateral Commission: "Entrepreneurs who are not able to pay decent wages to employees, should withdraw from business" (Guz, 2011).

To sum up - I think that raising the minimum wage up to 50% of the average wage is not dangerous for the Polish economy and will not weaken its competitiveness.

REFERENCES

1. Addison J.T., M.L. Blackburn (1999), *Minimum Wages and Poverty*, Industrial Relations Review, vol. 52 (3)
2. Alpert, T., (1983), *The Effects of Minimum Wage on the Fringe Benefits to Restaurant workers*, Lehigh University, Bethlehem, Pa.
3. Borkowska, S., *Płaca minimalna a ograniczanie ubóstwa*, [in:] *Polityka społeczna. Wybrane problemy*, IPiSS, Warsaw 2005
4. Borkowska, S.,(2001), (Ed.), *Koszty pracy a rynek pracy*, IPiSS, Warsaw, (in Polish)
5. Brown, C., Gilroy, C., Kohen, A., (1982), "The Effect of the Minimum Wage on Employment and Unemployment", Journal of Economic Literature, no 20
6. Budnikowski, T., Bezrobocie wyzwaniem współczesności, Instytut Zachodni, Poznań 2009
7. Burkhauser, R., Couch, K. A., Wittenburg, B. C., *"Who Gets What" from Minimum Wage*, Hikes: Re-Estimation of Card and Krueger's Distributional Analysis in Myth and Measurement, The New Economic of the Minimum Wage, "Industrial and Labour Relations Review", 1996, Vol. 49, No. 3
8. Frieske, K. W., *O mankamentach propozycji Davida Hume'a i Stanisławy Golinowskiej*,[The shortcomings of the proposal by David Hume and Stanisława Golinowska] [in:] Polityka społeczna. Wybrane problemy. Wybór artykułów z lat 1999-2005, IPiSS, Warsaw 2005
9. Golinowska, S., *O przyczynach bezrobocia i polityce jej zwalczania. Głos w debacie*, [in:] *Polityka społeczna. Wybrane problemy*, IPiSS, Warsaw 2005

10. Gunderson, m., (2005), *Minimum Wages in Canada: Theory, Evidence and Policy*, Ottawa, Fair Labour Standards Review Commission
11. Guz, J., (2011), "Płaćcie nam godziwie", *Gazeta Wyborcza*, (19 August)
12. Hashimoto, M., (1982), "Minimum Wage Effect on Training on the Job", *American Economic Review,* December
13. Jacukowicz, Z. (2007), „Analiza minimalnego wynagrodzenia za pracę (Analysis of minimum remuneration for work)"Studia i Monografie, IPiSS, Warsaw, (in Polish)
14. Kamerschen, D. R., McKenzie, R. B., Nardelli, C., *Ekonomia*, Fundacja gospodarcza NSZZ „Solidarność", Gdańsk 1999
15. *Konwencje i Zalecenia Międzynarodowej Organizacji Pracy 1919-1994*, Wydawnictwo Naukowe PWN, Warsaw 1996.
16. Kurowska, A., (2008), "Skąd się bierze bieda?", Zeszyty FOR, no. 5, (in Polish) Wojciechowski, W. , (2008), Co robić aby więcej Polaków pracowało? Raport FOR i Izby Gospodarczej Towarzystw emerytalnych, Warsaw, (in Polish)
17. Leighton, L., and J. Mincer, (1981) "Effects of Minimum Wages on Human Capital Formation", [in:] Rottenberg, S., (ed), *The Economics of Legal Minimum Wages*, American Enterprise Institute, Washington D.C.
18. *Low Pay Commission Report* (2005), National Minimum Wage, http://www.lowpay.gov.uk/lowpay/report/pdf/dti-min_wage.pdf
19. Majchrowska, A., and Z. Żółkiewski (2012), „The Impact of |Minimum Wages on Employment in Poland", Investigaciones Regionales, Section Articles
20. *Mała encyklopedia ekonomiczna*, PWE Warsaw 1962
21. Mishel, R. H., Bernstein, J., Rassel, E. *Who Wins with a Higher Minimum Wage*, Economic Policy Institute Briefing Paper, Washington D.C. 1995
22. Neumark, D. and Wascher, W., (1997), „Do Minimum Wages Fight Poverty?, Working paper, National Bureau of Economic Research, No. 6127
23. Neumark, D. and Wascher, W., (2007), "Minimum wages and Employment", IZA Discussion Paper, No. 2570, Bonn
24. OECD (2012), *Economic Outlook*, Issue 2, Deceber
25. Ragan, J. F., (1977), "Minimum Wages and the Youth Labor Market", *Review of Economics and Statistics*, No 59, May
26. Rocheteau, G., Tasci, M., *The Minimum Wage and the Labor Market*, Federal Reserve Bank of Cleveland, Cleveland 2007
27. Roth, J. D., (2007), *Who Earns Minimum Wage? A Statistical Profile, "Get Rich Slowly", Personal Finance That Makes Cents,* http://www.getrichslowly.org/blog/2007/10/09/who-earns-the-minimum-wage/
28. Sloman, J., *Podstawy ekonomii*, PWE, Warsaw 2001
29. Smith, A., *Badania nad naturą i przyczynami bogactwa narodów*,[An Inquiry Into the Nature and Causes of the Wealth of Nations], PWN, Warsaw1954
30. *Statistical Bulletin*, (2013) Central Statistical Office, Warsaw
31. *Statistical Yearbook of the Republic of Poland* (2011), Central Statistical Office, Warsaw
32. Suchecki, B., (1999), "Narzędzia kształtowania dochodu godziwego w Polsce", [Policies for decent income in Poland], [in:] S. Borkowska [Ed.], *Wynagrodzenia godziwe. Koncepcje i pomiar*, IPiSS, Warsaw, (in Polish)
33. Wessels, W., (1980), *Minimum Wages: Fringe Benefits and Working Conditions*, American Enterprise Institute, Washington D.C.

34. Wessels, W., (1999), Wpływ płac minimalnych na świadczenia pracowników, [in:] Kamerschen, D. R., McKenzie, R. B., Nardelli, C., *Ekonomia*, Fundacja gospodarcza NSZZ „Solidarność“, Gdańsk
35. Wyźnikiewicz, B., *Wzrost minimalnego wynagrodzenia jest szkodliwy dla gospodarki*, „Gazeta Wyborcza”, 6.12.2012.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE VALUE CHAIN OF A SUSTAINABLE DEVELOPMENT ORGANISATION

Dr. Jan Chadam, Gaz System Ltd. Poland
Email: jan.chadam@gaz-system.pl

Mrs. Malgorzata Polkowska, Gaz System Ltd. Poland
Email: malgorzata.polkowska@gaz-system.pl

Dr. Zbigniew Pastuszak, Maria Curie-Sklodowska University Poland
Email: z.pastuszak@umcs.lublin.pl

Dr. Nada Trunk-Sirca, University of Primorska Slovenia
Email: nada.trunk@guest.arnes.si

ABSTRACT

Purpose: *Balancing the economic, social and environmental aspects of company operation becomes a new DNA of the organization and a management philosophy for generating tangible results, not only for the company itself, but also its stakeholders. The article seeks to describe the approach to managing aspects of sustainable development and their integration into the business strategy and operations a Polish gas sector company.*
Structure / methodology / approach: *The text will detail how to integrate aspects of sustainable development, translated into company environment as corporate social responsibility (CSR), with particular business areas of company operation. Also presented will be a chain of values and synergies within the Company managed from the sustainable development perspective and the tangible effects of this management philosophy in terms of increased company value, changing organizational culture, improved efficiency, enhanced confidence from the organisation's internal and external environment and effective risk management.*
Conclusions: *Company management from the sustainable development perspective combined with a strategic approach to and implementation of this management philosophy ensure that the organization is lead in a responsible manner, and contribute to the increase in its tangible and intangible value. It is also conducive to effectively creating added value for the organisation's internal and external environment, which cannot be achieved if the business and CSR aspects of operation are not considered strategically and effectively integrated with each other.*
Originality / value: *The example covered in the article represents a proprietary model for CSR implementation which, after several years, has brought about tangible economic, social and environmental results. Following the change in its management philosophy and way of conducting business, the company was ready to undertake the implementation of new ambitious projects which are important for the national economy in terms of energy security. It has become a leader of the integration of gas transmission systems in Central Europe. The new management approach allowed the organisation to build new economic, social and environmental capital.*

Classification: Case study

Keywords (1-10): Sustainable development, Corporate social responsibility (CSR), Shared value, Value chain, Strategy

INTRODUCTION

The global economic crisis we have been experiencing for several years forced international institutions to investigate its causes and the mechanisms that need to be implemented in business processes in order to prevent such developments from happening in the future and achieve lasting improvement in the form of a sustainable development of the world's economy (Bonini, 2011; Chouinard et al., 2011; Economist Intelligence Unit, 2009). The European Parliament clearly indicated that the current global economic crisis arose from fundamental errors with respect to transparency, accountability, responsibility and from short-termism (European Parliament, 2013). Global institutions, including the United Nations, increasingly conclude that corporations may contribute to the development of a social market economy by providing jobs and facilitating economic recovery. In this context, the approach to corporate social responsibility (CSR) gains special importance as an element that enables the implementation of the sustainable development concept at the company level and is looked at in a broader context of the organisation's impact on the community it operates in and on the competitiveness of the economy (Du et al., 2010; Kotler & Lee, 2004; Pohl & Tolhurst, 2010). The UN and the European Commission set out the strategic directions for the implementation of the sustainable development concept at the company level but each firm should individually define the areas and CSR tools that are relevant to its business model (Laszlo, 2005). As is evident from a review of world trends in CSR implementation, the concept may be beneficial to organisations only fully integrated with their business strategies and is duly implemented in consideration of the company's external environment.

This meaning of social responsibility of business is also supported by the international standard ISO 26000. The fundamental characteristic of social responsibility is the organisation's readiness to accommodate community and environmental considerations in its decision making and to be held accountable for the impact of its decisions and actions on the community and the environment. This means both transparent and ethical behaviour that contributes to sustainable development, is in line with the applicable laws and consistent with international standards of conduct. It also means that social responsibility is an inherent element of all the activities of the organisation is practised in its relationships and takes into account stakeholder interests (Guidance on social responsibility, 2013). The concept of sustainable development, adapted into business practice as the Corporate Social Responsibility (CSR), is a chance to forge a long-term increase in the company’s value, which, in a longer term, translates into a competitive and responsible economy. For the CSR to play a strategic role, it has to be properly implemented at the company level.

In this article we are going to discuss the latest approach to the sustainable development concepts at the company level. The first of them known as creating shared value is presented by M. Porter and M. Kramer (2011). The second one proposed by W. Visser concerns the theory of the evolution of social responsibility from CSR 1.0 to CSR 2.0 (Visser et al., 2010).

Both approaches provided a stimulus for the implementation of the sustainable development concept and the integration of the aspects of social responsibility with the corporate business strategy in GAZ-SYSTEM S.A., a company operating in gas industry in Europe. Over four years ago, the company embarked on the process of transformation in strategic and operational management by integrating its business activities with sustainable development

aspects. As a result, business objectives are effectively achieved through increased involvement of the employees and good relations with the stakeholders and local communities where the company has an active business presence. Internally, the integration process has had a very positive impact on the organisation, especially in such areas as organisational culture or efficiency improvement, and ultimately has led to substantial growth of the company's value.

Strategic approach to sustainable development in business from CSR 1.0. to CSR 2.0

Wayne Visser identified five stages of CSR maturation, which go in parallel to economic growth (Figure 1). The first four stages (the Age of Greed, the Age of Philanthropy, the Age of Misdirection, the Age of Marketing) belong to CSR 1.0. Fully mature companies find themselves in the fifth stage of CSR implementation – the Age of Responsibility. Visser and Tolhurst argue that a positive contribution of to society is the essence of CSR 2.0 and it is not about marginal promotional or philanthropic initiatives but about the business philosophy (Visser & Tolurst, 2010). According to this theory, CSR should no longer be understood as "corporate social responsibility", but rather should be taken to mean "corporate sustainability and responsibility". CSR understood in this way is definitely an inherent part of the business strategy and an overriding philosophy in all areas of a company's operations.

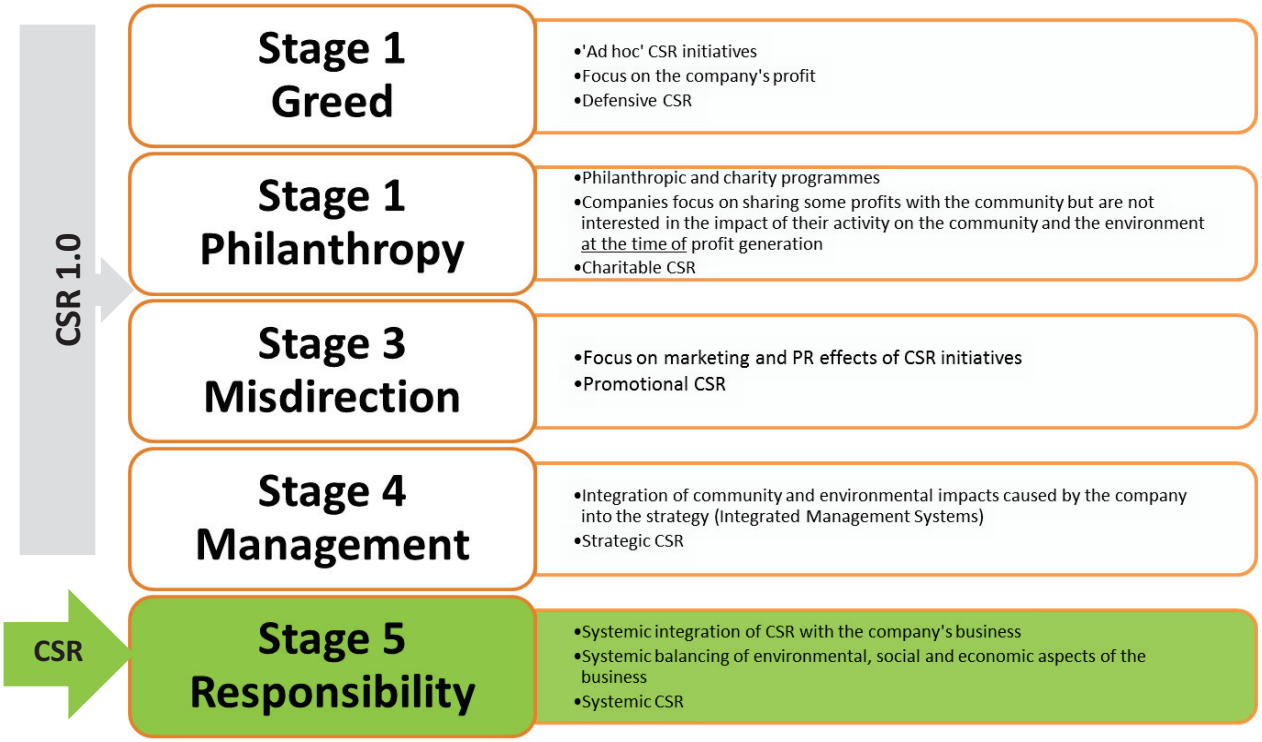


Figure 1. Evolution of CSR maturity
Source: Own analysis based on Visser (2011).

Top management should act as the ambassadors and key sponsors of the CSR implementation within an organisation as they set the strategic direction and goals and define the path the organisation must follow in order to implement business objectives taking into account the social and environmental impact of the organisation. The CSR 2.0 theory holds that

sustainable efficient growth that accommodates the interests of all stakeholders is key for the organisation.

In order to achieve efficient implementation of CSR 2.0 in business, a company has to apply certain principles that make up the DNA of this concept (Visser, 2011):
1. Connectedness – create multi-stakeholder relationships instead of mere relationships with shareholders and focus on value-creation.
2. Scalability – implement socially responsible practices on a sufficiently large scale and focus on the real benefits for society and the environment (rather than PR effects).
3. Responsiveness – respond to global problems even when this is uncomfortable for the company.
4. Duality – take into account a broader context, including local conditions, and select solutions that are most appropriate for them, instead of pre-defined principles.
5. Circularity – design actions that will be sustainable from the beginning to the end, avoid waste of resources, replenish human capital and nourish local communities.

Sustainable development should be the purpose of business. This goal may be achieved through responsible management of the company, primarily in the following aspects (Visser, 2011):

- economic sustainability and financial responsibility,
- human sustainability and labour responsibility,
- social sustainability and community responsibility,
- environmental sustainability and moral responsibility,
- investment sustainability and responsible investments.

Consequently, the essence of CSR 2.0 lies in a broad, comprehensive scale of actions in all the areas of business activity of the company and its responsible management at all levels.

Creating Shared Value (CSV)

In the context the discussion on the causes of the economic crisis, a similar theory was proposed by M. Porter and M. Kramer by defining the creation of shared value for business and society (Porter & Kramer, 2011). The theory moves away from a narrow perception of value understood as the optimisation of short-term financial performance. It encourages the accommodation of the needs of customers and a full range of stakeholders, which should determine the long-term success. Today, companies have to restore the ties between the business and the society and regain the trust of the public (Blowfield & Murray, 2008; Shockley-Zalabak et al., 2010; Cheney et al., 2007). The principle of creating share value consists in the generation of economic value in such a manner that, at the same time, creates social value by addressing the needs and problems of the society (Porter & Kramer, 2011). The authors argue that shared value is not synonymous with social responsibility, philanthropy or even sustainable development – it is a new way of achieving economic success. Rather than being a marginal component of a company's activity, it lies at the core of the philosophy and underpins the business. Porter and Kramer argue that the notion of share value may trigger a major change in the thinking about business, as they believe that creating shared value, instead of pure profit, should be the purpose of business. This in turn will unleash opportunities that will lead to increased innovation and productivity across the world's economy. The shared value concept assumes that markets are driven by social needs

rather than just by shareholders' expectations. At the core of this concept lies a conviction that the competitiveness of a company and the condition of the communities around it are very strongly related. As a result, overall resources of the economic and social value are increased.

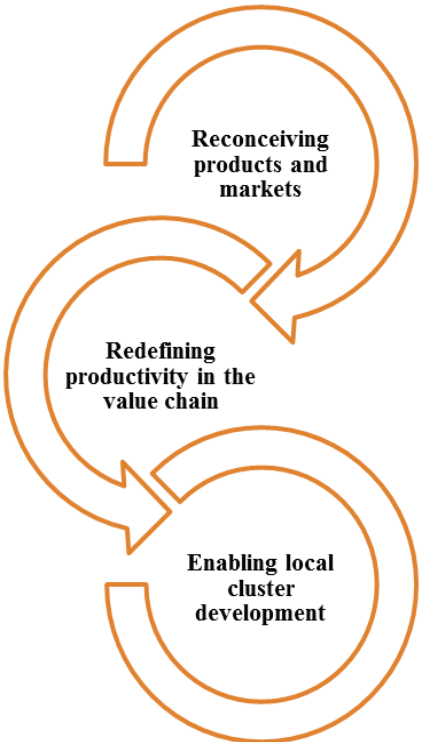


Figure 2. Creating shared value.
Source: Own analysis based on Porter and Kramer (2011).

By generating a profit that is related to a social purpose organisations can accelerate social progress and, at the same time, continue to grow. The creation of shared value implies the conformity to legal and ethical standards, as well as the mitigation of any damage caused by companies. The concept reflects a new way of companies' thinking about who are their customers, what is productivity and what are the external forces driving a company's success.

The shared value responds to the expectations of customers, business partners, employees and local communities a company operates in. The resulting competitive advantages will enable the creation of sustainable and long-term value of an organisation.

Case study: Change of management philosophy – strategic approach to social responsibility in GAZ-SYSTEM S.A.

GAZ-SYSTEM S.A. is responsible for the security of gas transportation in Poland, expansion of the transmission network, as well as investment projects integrating the European gas transmission system.

The first step to fostering social responsibility at GAZ-SYSTEM S.A. was taken in 2009 when the Code of Ethics was developed in cooperation with the employees and subsequently implemented. The Code defines the principles of ethically acceptable conduct and emphasises the key roles of the values the Company aspires to, including responsibility, commitment, professionalism, team work and respect.

Since 2009, the company has been a member of the Global Compact, an initiative announced by the UN Secretary-General, and has declared its commitment to the ten universal principles in the areas of human rights, labour relations the environment and anti-corruption. GAZ-SYSTEM S.A. puts a lot of emphasis on preventive environmental management while developing initiatives which are aimed to promote ecological responsibility and the application and spread of clean technologies. Each year, in line with the Global Compact requirements, GAZ-SYSTEM S.A. releases the Communication on Progress (COP) report.

Since joining the UN Global Compact in 2009, launching the Code of Ethics and adopting a set of clearly defined values, GAZ-SYSTEM S.A. has been able to consistently build its business strategy which incorporates the focus on sustainable development in the management of the organisation and integrates all the social responsibility measures taken within the company.

From that moment the company launched also the process of redefining its business objectives and the needs of the community in which it carries out its business through balancing the social, environmental and economic aspects. The stakeholders, both internal (the management) and external (customers, supervisory institutions) were invited to the process of business strategy redefinition. A series of workshops and external research resulted in the definition of strategic directions, including the one that is oriented at the management of the company from the sustainable development perspective and, at the same time, integrates all other business activities undertaken as part of other strategic directions. The implementation of sustainable development principles has become a core part of the corporate strategy, as sustainability is at the heart of our corporate culture, reflecting the values the Company aspires to. The process was largely in line with the CSR 2.0 implementation model proposed by W. Visser (Figure 3).

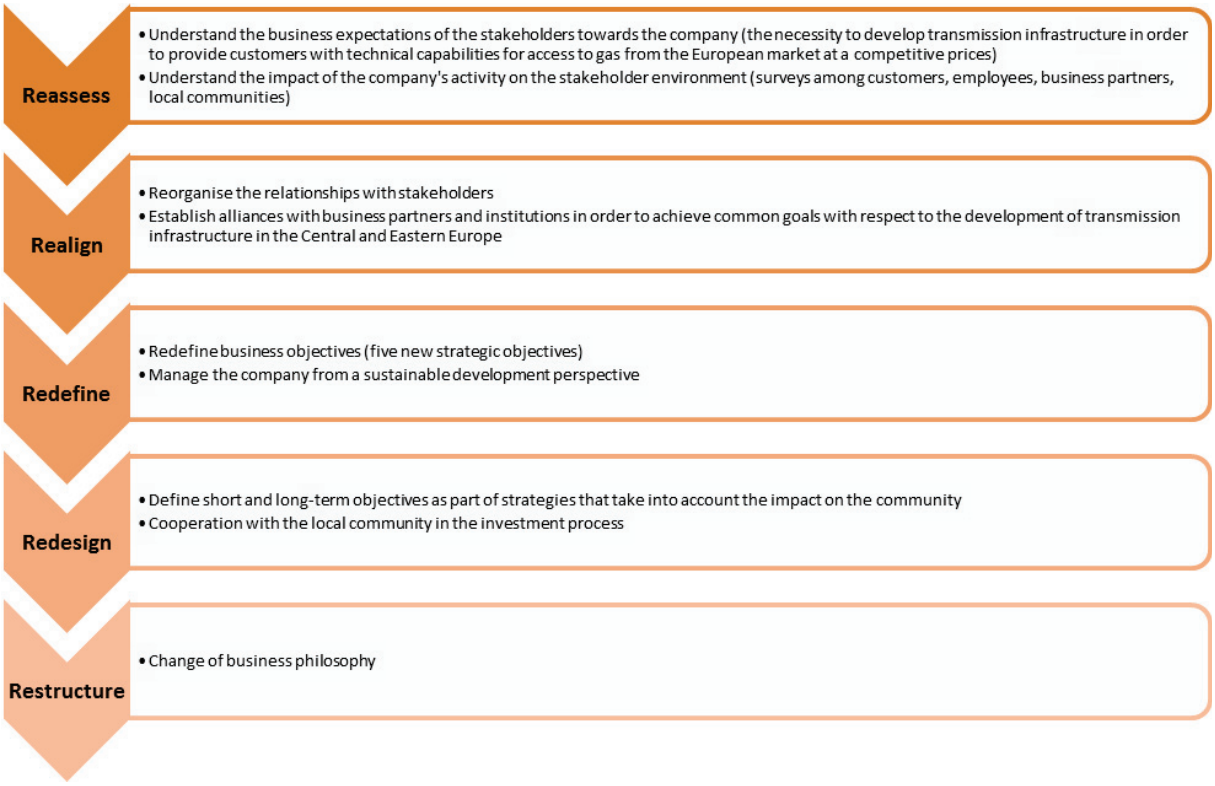


Figure 3. Implementation of CSR 2.0 in GAZ-SYSTEM S.A.
Source: Visser (2011).

This also means that in the process of redefining its business strategy the company applied the theory of creating shared value defined by Porter and Kramer. The company **reconceived its products and markets** by introducing new services and opening up to the opportunities of cooperation with other countries with regard to the expansion of gas infrastructure in Europe (the Czech Republic, Slovakia, Lithuania, Germany, Denmark). GAZ-SYSTEM S.A. also **redefined productivity in the value chain** by focusing on long-term, sustainable development through better utilisation of resources, improved work efficiency and more efficient processes management within the company. Furthermore, GAZ-SYSTEM S.A. **enabled local cluster development** through communication, community and promotional activity among the local communities where the company carries out its business (operates gas pipelines and builds new ones). Among other things, the company actively involved local communities in the implementation of ecological and environmental projects affecting their area. For several years, as part of the Natural Energy Fund, GAZ-SYSTEM S.A. supports local initiatives aimed at the improvement of natural environment, working together with municipalities and local institutions.

Company's key objectives include enhancing Poland's energy security and integrating European transmission systems with a special focus on such priorities as environmental protection and delivery of strategic investments in cooperation with local communities. The company is committed to pursuing sustainable development, which is a long term and multifaceted process reaching deep into our business practices. The so-defined strategic objectives are directed at ensuring that all our activity is carried out in line with sustainable development principles. While being in full compliance with these principles, GAZ-SYSTEM is dedicated to providing the security of our gas transmission system, as part of the

EU gas network, Creates conditions for the development of a liberalized natural gas market in Poland to boost the consumption of natural gas as an environmentally friendly fuel, Our work is therefore focused on ensuring lasting improvements in our operational and organisational performance to consolidate our position as a significant player on the EU gas market. Integrating the sustainable development concept with business strategy is of key importance to ensuring its efficient implementation at company level. A similar approach was adopted at GAZ-SYSTEM S.A., where the fifth strategic objective, concerning company management from the sustainable development perspective, determines all our work towards the delivery our adopted strategy (Figure 4).

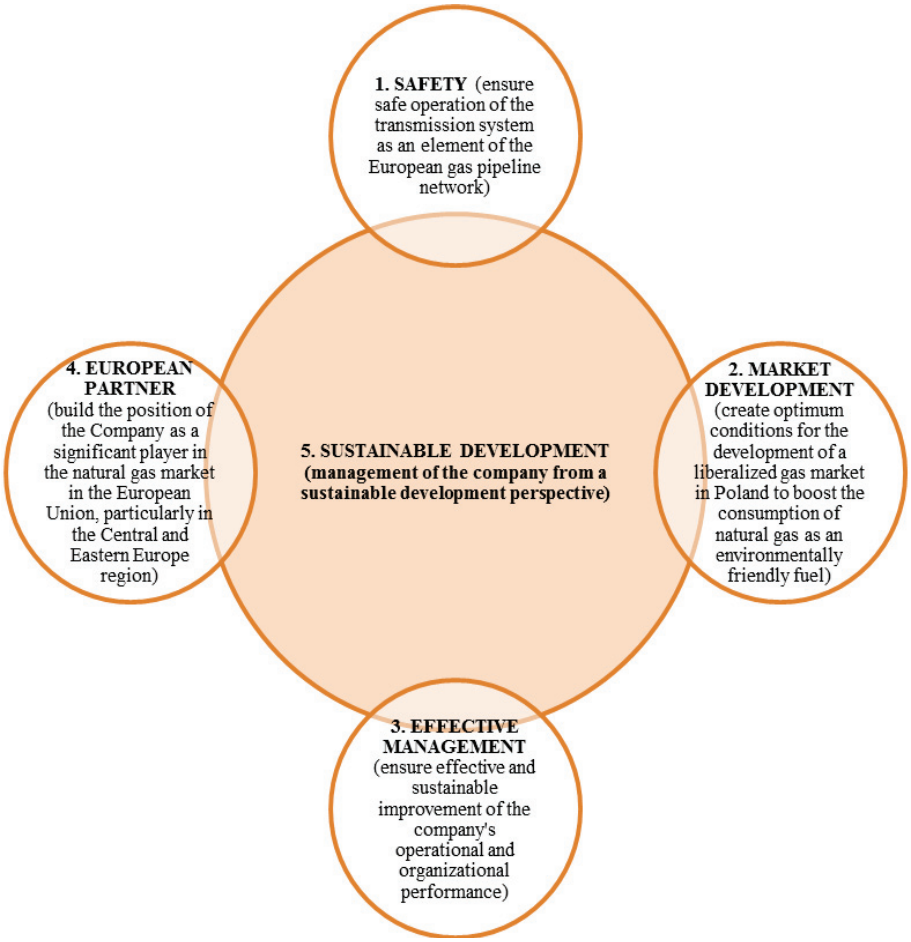


Figure 4: Strategic directions of GAZ-SYSTEM S.A.
Source: GAZ-SYSTEM S.A.

Case study: The value chain in GAZ-SYSTEM S.A. and the management from the sustainable development perspective

The incorporation of sustainable development dimension to the company's mission and vision, as a vital component of the management strategy and its close integration with all business areas of the company enabled a synergy effect and led to an individual value chain of the company (Figure 5). GAZ-SYSTEM S.A. understands CSR more broadly than mere community initiatives, philanthropy or promotion of environmental awareness, i.e. as an

inherent component of the management approach, which, in 2011, was incorporated to the company's strategy as the fifth strategic direction.

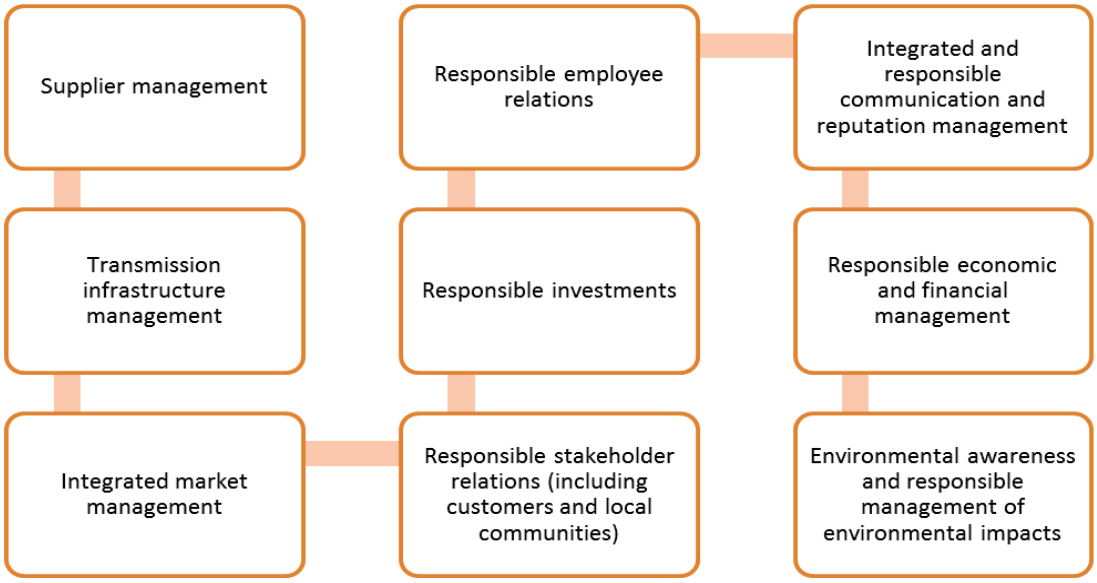


Figure 5. The value chain in GAS-SYSTEM S.A. as the effect of company management from the sustainable development perspective
Source: own analysis based on case of GAZ-SYSTEM S.A.

The integration of sustainable development aspects with the business areas of the company enables a comprehensive approach to building the organisation's value in individual areas, taking into account the influence on the society, the environment and the economy.

Owing to such business philosophy it is possible to build responsible relations with employees. For several years, the company has been ranked among Top Employers in Poland and in Europe, according to surveys carried out by the international firm A.ON Hewitt. Over a few years' time employee commitment increased from the level of 28% in 2007 to 85% in 2012.

In addition, for the last few years GAZ-SYSTEM S.A. has been implementing an ambitious investment programme including the construction of over 1000 km new gas pipelines in Poland and the first receiving terminal for liquefied natural gas (LNG) in Świnoujście on the Baltic coast. The value of the investment programme by 2014 is estimated at approx. USD 3 billion. The company attaches great importance to responsible execution of its investment projects in terms of their environmental, social and economic impact. Comprehensive communication with local communities about the projects being underway is also recognised as a key part of the investment process. GAZ-SYSTEM S.A. regularly organises information meetings for local authorities and landowners whose property is affected by the pipelines developed by the company. The meetings are attended by the employees of GAS-SYSTEM S.A. who are responsible for the project implementation. The representatives of contractors are also invited. The meetings offer an opportunity for discussing key issues concerning the project implementation, rights of way to property for the time of construction and

compensation payable to landowners. The participants receive information materials (leaflets on the project and the compensation procedure, posters with the pipeline route, etc.). Some meetings take the form individual consultations during which landowners may obtain information about issues of their concern, and trace the route of the gas pipeline running through their properties on professional maps.

In some municipalities information points are also being set up; these are an additional source of information for residents and anyone interested in the company's projects. In the years 2011-2012, in connection with the implemented in different regions of Poland, GAZ-SYSTEM S.A. held over 100 meetings with local communities, which were attended by over 2000 people. At present, the company is engaged in communication activities in over 70 municipalities in Poland. Each year, the company organises, on average, over 100 initiatives addressed to local communities.

The management of the company from the sustainable development perspective also facilitated the enterprise risk management (ERM) resulting in a more comprehensive and effective solution.

As a notable evidence of its commitment to balancing its economic interests with the expectations of customers, the company decided to reduced, already twice, its tariffs for gas transmission services. Thereby the company demonstrated that it is capable of financing a costly investment programme (worth over USD 3 billion until 2014) in a responsible manner, through efficient cost management and attracting favourable forms of financing for its investment projects (support from the EU, EBRD and EIB). The above-mentioned financial institutions operate very restrictive lending regimes, which involve examining the applicants' eligibility in terms of social performance and compliance with European standards. GAZ-SYSTEM reporting policy, including the annual COP reports for Global Compact and the reporting based on the internationally recognised GRI standard, greatly improve our credibility vis-à-vis the European financing institutions involved in our investment projects.

The integrated management of sustainable development aspects also enables the comprehensive management of corporate communication and image. Earlier In 2012, GAZ-SYSTEM opted for integrated reporting in accordance with the guidelines of the Global Reporting Initiative (GRI), The reports describe in detail the sustainable development initiatives undertaken by the company and present both the financial and non-financial performance. The document is updated annually. In order to ensure the comprehensiveness of the report, the company organised a series of workshops for its key staff and managers to define practical reporting guidelines. The participants collected essential data concerning the projects implemented by the company within respective areas of the business strategy. As a result, the report provides a comprehensive overview of the company's performance, including economic, environmental and social aspects according to GRI level B criteria. Its content was developed in consultation with our key internal stakeholders and approved by leaders of particular thematic areas. The reported data has been selected based on its materiality, which is defined by the company as the issues that are relevant in the context of sustainable development, both for the organisation itself and its stakeholders.

The impact of the integrated approach adopted by GAZ-SYSTEM in the field of corporate social responsibility, including integrated, consistent and reliable communication, is also

reflected in our positive media image. In 2012, over 90% of the nearly 6000 articles published gave a positive impression of the company, with the rest being predominantly neutral (a mere 0.02% of the publications carried negative overtones), which created a substantial positive media equivalent value.

The company did also implement a framework for managing the sustainable development aspects. To this end, the company prepared a document that describes the rights and obligations of the individual parties in the organisation and sets out the relevant communication principles. It is also an effective tool for the integration of social responsibility initiatives on a company-wide basis, and for the management of environmental, social and economic aspects.

In a 2012 survey conducted by a marketing research company, GAZ-SYSTEM was found to be perceived as modern, innovative and trustworthy brand. It enjoys the image of a prestigious employer that takes care of its employees and is a desirable place to work. Other features that make GAZ-SYSTEM S.A. from other companies include professional staff and dynamic growth, as well as overall reliability, integrity and trustworthiness. The brand connotations most frequently mentioned by the respondents were related to responsibility. The level of employee identification with the corporate brand is very strong, as demonstrated by the score of 82 out of 100. In the survey, business partners highlighted such advantages of the relationship with GAZ-SYSTEM S.A. as equal treatment afforded to all parties, operational effectiveness, responsiveness to customers' needs and professionalism of employees. The general perception is that the company has set the right directions for its growth and should carry on pursuing them. While local authorities are also positive about the cooperation with GAZ-SYSTEM S.A., some of them have expressed the need for more active policies designed to inform stakeholders of on-going and upcoming investment projects.

The company continuously develops its responsible approach to business and to this end, in 2013, it is planning to implement the ISO 26000 standard and integrate it with the currently operated Integrated Management Systems (for environment, quality and OHS).

CONCLUSIONS

Our consistent and long-term CSR policy which is fully integrated with the company's business strategy have brought measurable benefits to GAZ-SYSTEM by enhancing employee commitment and community trust levels. Socially responsible company management also translates into improved relations with stakeholders (business partners, financing institutions). The change of management philosophy allowed the company to build new economic, social and environmental capital. It also enabled the development of new competencies within the organisation and the fulfilment of new ambitious challenges related to the execution of investment projects that lead to improved competitiveness of the economy and energy security in Europe. This management model supports an effective creation of shared value and responsiveness to the expectations of customers and local communities as regards the company's commitment to promoting community interests. GAZ-SYSTEM S.A. brought a new quality to building stakeholder relations based on the responsibility of the company and its employees for their actions and for creating value also for the communities they operate in.

REFERENCES

1. Blowfield M., Murray A. (2008), *Corporate Responsibility: A Critical Introduction*, Oxford University Press.
2. Bonini S., (2011) *The business of sustainability (McKinsey Global Survey results)*, McKinsey&Company.
3. Cheney G., Roper J., May S. (2007), *The Debate Over Corporate Social Responsibility*, Oxford University Press.
4. Chouinard Y., Ellison J., Ridgeway R. (2011), *The Big Idea: The Sustainable Economy*, Harvard Business Review, October.
5. Du S., Bhattacharya C.B., Sen S. (2010), *Maximizing Business Returns to Corporate Social Responsibility (CSR): The Role of CSR Communication*, International Journal of Management Reviews, British Academy of Management.
6. Economist Intelligence Unit (2009), *Management magnified. Sustainability and corporate growth*.
7. European Parliament (2013), *Report on corporate social responsibility: accountable, transparent and responsible business behaviour and sustainable growth*, (2012/2098 (INI)).
8. *Guidance on social responsibility*, ISO 26000:2010, available at: http://www.iso.org/iso/iso26000 (accessed 20 April 2013).
9. Kotler P., Lee N. (2004), *Corporate Social Responsibility: Doing the Most Good for Your Company and Your Cause*, Wiley.
10. Laszlo Ch. (2005), *The Sustainable Company: How to Create Lasting Value through Social and Environmental Performance*, Island Press,.
11. Pohl M., Tolhurst N. (2010), *Responsible Business: How to Manage a CSR Strategy Successfully*, Wiley.
12. Porter M.E., Kramer M.R. (2011), "Creating Shared Value", *Harvard Business Review*, January-February.
13. Shockley-Zalabak P.S., Morreale S.P., Hackaman M.Z. (2010), *Building the High-trust Organization*, published by Jossey- Bass, San Francisco.
14. Visser W. (2011), *The Age of Responsibility: CSR 2.0 and the New DNA of Business*, John Wiley & Sons.
15. Visser W., Tolhurst N. (2010), *The World Guide to CSR: A Country-by-Country Analysis of Corporate Sustainability and Responsibility*, Greenleaf.
16. Visser W., Matten D., Pohl M., Tolhurst N. (2010), *The A to Z of Corporate Social Responsibility*, John Wiley & Sons.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

OUTSOURCING STRATEGIES AND NEGOTIATION POWER IN SECURITY SECTOR

**Jouni Juntunen, University of Oulu/ Oulu Business School, Department of Marketing,
P.O.Box 4600, FI-90014 University of Oulu, Finland,
E-mail: jouni.juntunen@oulu.fi,
Tel: +358 294 48 2589; Fax: +358 8 553 2906**

**Mari Juntunen, University of Oulu/Oulu Business School, Department of Marketing,
P.O.Box 4600, FI-90014 University of Oulu, Finland,
E-mail: mari.juntunen@oulu.fi,
Tel: +358 294 48 2584; Fax: +358 8 553 2906**

**Vesa Autere, Defence Command J4/Ops Head of Movement &Transportation,
P.O.BOX 919, 00131 Helsinki, Finland,
email: vesa.autere@mil.fi, Tel: +358 299 51 0425**

**Pekka Kess, University of Oulu, Department of Industrial Engineering and Management,
P.O.BOX 4610, FI-90014 University of Oulu, Finland,
E-mail: pekka.kess@oulu.fi, Tel: +358 294 48 2932, Fax: +358 8 553 2904**

ABSTRACT

Purpose: *This research studies how the security-related outsourcing strategies and negotiation power of the public sector and the military and the relevant logistics service providers influence for indirect logistics costs.*
Design/methodology/approach: *A tentative model was devised from theoretical literature comparing how logistics strategy and negotiating power impact for total logistics costs through improved service quality and/or unit-cost reductions. The model was tested using survey data from 149 respondents from the Finnish Defence Forces, and the public sector and industrial firms in Finland via structural equation modelling analysis.*
Findings: *Contrary to the approach of classic assumption, where negotiating power correlates with strategy, the findings indicate that negotiating power and strategy do not correlate. However, together they affect direct costs and perceived service quality, which consequently decreases the indirect logistics costs.*
Research limitations/implications: *By understanding different impacts of strategy and negotiation power on direct logistics cost and perceived service quality, buyer of the logistics services may increase the service performance of their supply chain. The data is collected from one country, which may cause bias. Further studies would be required to test this research proposal in other countries.*
Practical implications: *To obtain improve service performance of the supply chain, buyers of logistics services could learn from the public sector and the military on how to use negotiating power and strategy to obtain better service in addition to short-term cost reductions, as both of them explains reduced costs in the long run.*

Originality/value: *This study is important to practitioners as well as academics since there is little quantitative research available regarding importance of logistics strategy and its impact to negation power and service performance of the supply chain.*

Keywords: Logistics strategy, negotiating power, service performance, structural equation modelling, supply chain management, military logistics
Classifications: a. Research paper

INTRODUCTION

According to Mentzer et al. (2001), supply chain management (SCM) can be seen as "the systemic, strategic coordination of the traditional business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole". Because SCM tends to work best under circumstances where buyers have more leverage than suppliers (Cox, 2004a), and because the military is often a powerful logistics service buyer, we assume that its procurement activity would provide an interesting context for studying the influence of strategy and negotiation power for logistics costs. However, it is important to remember that there are usually several other factors influencing logistics costs, such as confidence and supply chain agility, which are not considered in this study.

Willcocks et al. (1999) argue that in the military, only non-core activities or its in-house core activities involving a partnership to mitigate the risks of outsourcing can be considered suitable functions for outsourcing. In the military context, there is no room for opportunistic behaviour especially among logistics service providers because failure of a supply chain to provide for forces operating in enemy territory can lead to enormous losses (Song et al., 2000; Juntunen et al., 2012). In Finland, the majority of the military is made up of reservists and thus having also adequate domestic transportation services is always important for the Finnish Defence Forces (Juntunen et al., 2011a). Further, in Finland, the military cooperate with the security-related functions of the public sector as much as possible in their daily routines and hence the both, military and public sector, have to use service providers they can trust during crisis situations. Further, military buy logistics services with a large and thus also LSPs (logistics service providers) are eager to have the military forces as their customer (Juntunen et al., 2011b).

The purpose of this research is to study how the effective strategies and negotiation power of the public sector and the military and the relevant logistics service providers influence for indirect logistics costs via service quality and direct logistics costs. To retort for this question, a tentative model is devised from theoretical literature and the model was tested using survey data from 149 respondents from the Finnish Defence Forces, and the public sector and industrial firms in Finland via structural equation modelling analysis.

We found that contrary to the approach of classic assumption, where strategy explains negotiating power, the findings indicate that strategy and negotiating power do not have statistically significant relationship. However, together they affect direct costs and perceived service quality, which consequently decreases the indirect logistics costs. Hence, to obtain improve service performance of the supply chain, buyers of logistics services could learn

from the public sector and the military on how to use negotiating power and strategy to obtain better service in addition to short-term cost reductions, as both of them explains reduced costs in the long run.

The paper first presents a theoretical background with tentative model based on previous research in logistics, service and relationship management. The following sections explain research methods and present the empirical data with the empirical analysis. Finally there will be discussion and conclusions which include also limitations and suggestions for further research.

THEORETICAL BACKGROUND

The concepts employed and their interconnections

According to Langley and Holcomb (1992), the value created through logistics has been viewed as one of cost efficiency versus competitive service levels. Another important aspect is the use of strategic alliances and long-term partnerships to secure both goods and services (e.g. Gentry, 1996) and all of these considerations is important when it comes to military logistics. Cost efficiency and service level need to endure within industry standards while simultaneously securing an adequate logistics capacity during unexpected crises (Juntunen et al., 2012). Hence, there is a strong agent-principal problem; how to make sure that LSPs are willing to provide first class services during crises situations? Further, according to Adam Smith (1776), incentives for agents are the dominant factor for efficiency. Because several contracts are vague or silent on a number of key issues and can give a room to opportunistic behaviour (Tirole, 1999), the contractual dilemma is a possible problem where the divergent interest between agent and principal will predictably lead to individually opportunistic behaviour and joint losses (Williamson 1971). Thus, security sector need to evaluate carefully what they can outsource, and especially, what kind of outsourcing strategy they have. In addition, it is a critical task for managers to understand and mitigate abnormal behaviours across the supply chain and agency theory serves this need by providing them with a useful tool to respond to transaction cost dilemmas through contractual and non-contractual remedies (Fayezi et al., 2012).

The classic economics standpoint is that in the long run there is a trade-off between service quality and costs (Juntunen et al., 2010), however, there are also studies which found that this trade-off may exist between direct cost and service quality but not between service quality and indirect or total costs (e.g. Juntunen et al., 2012). Unfortunately, because the relevant literature shows important discrepancies regarding the activities that should be included in the definition of logistics costs and there is no agreement on a exact definition of logistics costs, (Gonzales et al., 2007; Juntunen and Juntunen, 2010; Juntunen et al., 2012), this trade-off is challenging to study. Solakivi et al. (2009) divide logistics costs into direct and indirect costs where direct logistics costs include transportation and the cost of warehousing, whereas the sharing of indirect costs is much more difficult to determine because these are often in-house costs that may possibly be combined with various different functions. However, expenses related to physical operations are often quite clearly specifiable (Solakivi et al., 2009). In this research, we follow Juntunen et al. (2012) definitions where the term “direct logistics costs” includes transportation and warehousing costs, and “indirect logistics costs” includes

personnel costs and total logistics costs. In addition, because logistics costs do not have a specific universally-accepted definition even in the relevant literature, in this research respondents have given their answers based on their personal view of logistics costs in their line of business (e.g. Juntunen and Juntunen, 2010).

It is widely accepted decades ago that structure of the organization follows strategy (e.g. Chandler, 1962; Jones & Hill, 1988), and structure is the design of the organization through which the enterprise is administered. This can be extended for supply chain, and for example tight competition of suppliers weakens strategic networks and hence increases transaction costs (Jarillo, 1988). In addition, the industry structure view proposes that supernormal returns are mostly a function of a firm's membership in an industry with favorable structural characteristics (Porter, 1980; Dyer and Singh, 1998) and superior performance is a product of the correct "fit" between strategy and structure (Jones and Hill, 1988). Further, it is reasonable to assume, that management skills explains quality of strategy, and for example Grunert and Norden (2012) argue that management skills and character is positively related to bargaining power in SME loan bargaining. Hence we assume here that in addition to costs and performance of the supply chain, strategy influence also for bargaining power.

According to Juntunen et al. (2011a), a mathematical form of the Nash's (1951) negotiating model can be applied to logistics costs and the resulting profit sharing will reflect the relevant negotiating power. Because negotiating power consequences from factors such as market situation and relationship-specific assets among other things, negotiating power can be expected to influence direct logistics costs and of course also observed service quality.

Research model and hypotheses

According to Juntunen et al. (2011a; 2011b), the military does have considerable power as a buyer, but its negotiators must sustain a long-term perspective on outsourcing as the logistics services used must be capable of extreme efficiency even during a crisis. Further, military is very important customer for Finnish LSPs (logistics service providers) and thus also LSPs are willing to build up a strong strategic partnership with the military (Juntunen et al., 2011b). Therefore, we assume that the military, security sector and Finnish LSPs are willing to build up strategies that support cooperation and use their negotiation power to strengthen long-term partnership. In addition, because we study in this research deep partnerships, we assume that strategies of different actors support each other and hence respondents can actually evaluate their own strategy and it should affect also for their evaluation concerning military force's negotiation power. Hence our first hypothesis *(H1)* is that *existing strategy explains negotiation power*. Further, as strategy may influence also transaction costs and performance of the supply chain (e.g. Jarillo, 1988), our second hypothesis is that *existing strategy explains direct costs (H2)* and our third hypothesis is that *existing strategy explains experienced service level (H3).* The research model is developed based on Juntunen's (2010) outsourcing strategy model. It is expected that strategy may influence either direct costs or service quality.

Based on Nash (1951), negotiation power should influence for logistics costs and based on Juntunen et al. (2012) negotiation power should affect for service quality, we assume that *negotiation power explains direct costs (H4)* and *negotiation power explains observed*

service quality (H5). Finally, following Juntunen et al. (2012), we assume that *direct costs influence to indirect costs (H6)* and the *level of service influence to indirect costs (H7)*.

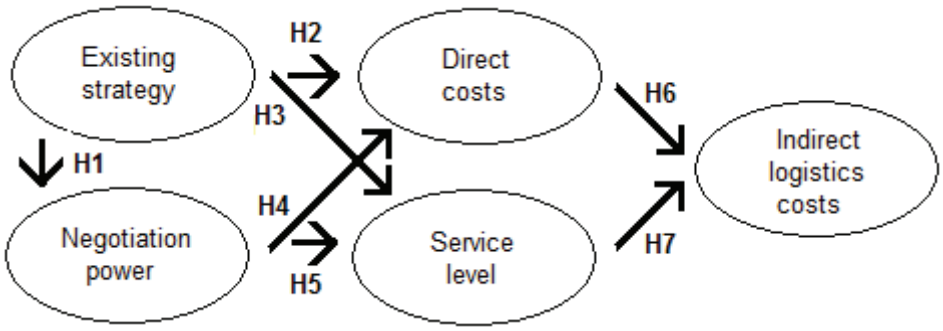


Figure 1: Research model

The concepts in the model can be seen as factors (or latent variables) that are not directly observable but can be concluded from other measurable variables. The operational measures were presented in a questionnaire as attitudinal statements based on a 7-point Likert scale. The anchors for questions related to service level were "weak" and "excellent" and all the other questions were anchored by "strongly disagree" and "strongly agree". The descriptions and the operational measures of the concepts are presented in Table 1.

Table 1: Latent variables and their operational measures

Latent variable	**Explanation and operational measures in the questionnaire**	**Label**
Service level	Refers to service levels experienced/produced	SERVICE
	• Recent experience of logistics service related to adhering to schedules	schedule
	• Recent experience of logistics service related to offering sufficient capacity	capacity
	• Recent experience of logistics service related to service-mindedness of personnel	service
Indirect costs	Refers to how outsourcing has decreased/is assumed to decrease the public sectors' and military's indirect logistics costs	INDICOST
	• Outsourcing has reduced total logistics costs	costlog
	• Outsourcing has reduced logistics personnel costs	costper

Latent variable	Explanation and operational measures in the questionnaire	Label
Direct costs	Refers to costs from physical logistics such as transportation and warehousing	DICOST
	• Outsourcing has reduced warehousing costs	costware
	• Outsourcing has reduced transportation costs	costtran
Existing strategy	Refers to the usage of the strategy in the respondents organisations	STRAON
	• We have made a logistics strategy in my organization	ologstra
	• Logistics strategy is informed in our organization and it has been take on use.	stratuse
	• Our logistics strategy is clear in leaded by top management	clearstr
Negotiating power	Refers to negotiating power with customers	POWER
	• Tight competition means customers can dictate the fees for transport	price
	• Transport entrepreneurs are "slaves" to the customers	slave
	• LSPs' expertise and impact do not affect their results, because customers take all the extra profits from the LSP branch	takeprof

METHODOLOGY AND ANALYSIS

Data description and estimation method

The data was collected in the spring of 2009 from the military, the security-related public sector and private industrial companies using web-based software. The sample size was 827 and we received 149 responses (18.01 %), which is quite acceptable considering recent developments in response rates (Larson, 2005). A non-response bias was studied by comparing different response waves (e.g. Armstrong and Overton, 1977) and in this study only 11.55 per cent of the responses in the entire questionnaire were not parallel in different waves. Hence, non-response bias seems not to be a problem in this study.

Responses originate from three groups. There were 45 respondents from the military, 33 respondents from the public sector and 71 from private enterprises. The respondents' organisations and companies from the public and private sectors represented were security related, and the non-military respondents from the private sector were requested to relate their

answers solely to their business relations with the military. Private sector companies are a vital part of the security sector in Finland, because there the military relies heavily on reservists. Respondents from the public sector included police and fire service personnel and health-care providers, whose organisations each have a duty to guarantee public safety and so to preserve functionality in crisis situations. Respondents included customer-relationship managers, service-production managers, brigade commanders, supply centre managers, rescue managers and materials managers (please see Appendix 1 for descriptive statistics relating to the groups). Even though minor differences among the responses, we continued on the structural equation models path because heterogeneous data should not be a problem if the structural equation model provides an acceptable fit (e.g. Juntunen et al., 2012).

The estimation was made using Lisrel software (Jöreskog et al., 2000; Jöreskog et al., 1993a). The normality of the variables was examined using Prelis 2 software (Jöreskog et al., 1993b) and the factor loading estimates, regression estimates between factors and estimates of the error terms were calculated using the ML (maximum likelihood) method based on a covariance matrix.

Data analysis

The research model was tested using the operational measures described above. Unexpectedly, despite the strength of the theoretical background to the research model, empirical analyses did not support the model as suggested (please see figure 2).

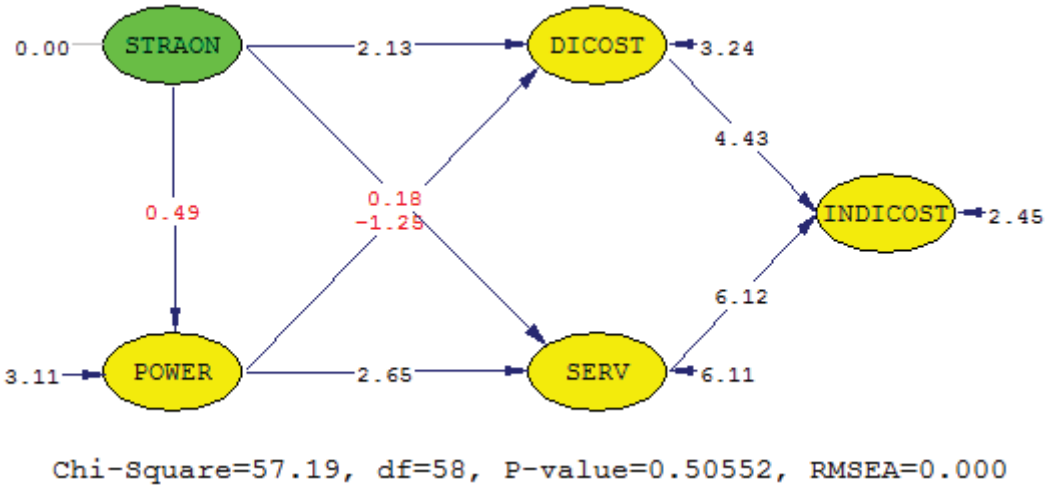


Figure 2: T-values in structural model

As seen in the figure 2, some relationships in the structural model are statistically insignificant level (t-values below 1.96 with red font – t-value 1.96 stands for 5 per cent probability). However, when removing statistically insignificant relationships, very interesting model was found. The new model is shown in Figure 3.

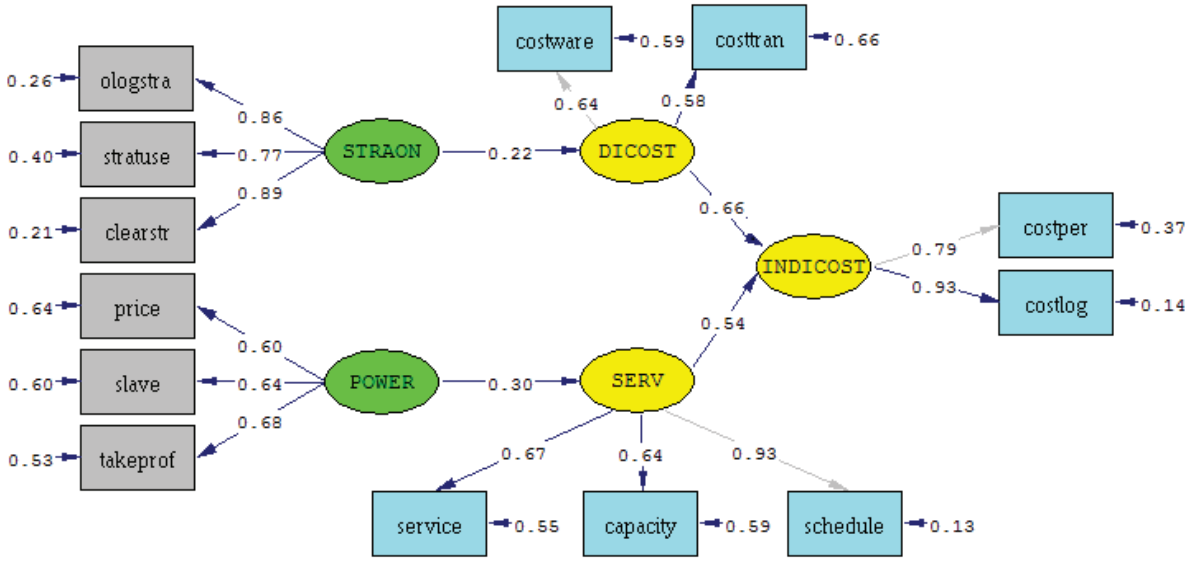


Figure 3. Empirical model

The empirical model provides a good statistical fit (see Table 2), and therefore recommendations based on the model will be clarified in the discussion below.

Table 2: Fit indices of empirical model

Test	**Value**	**P-value**
Chi-square (degrees of freedom)	57.86 (60)	0.554
RMSEA	0.046	
NFI	0.93	
CFI	1.00	
GFI	0.94	
SRMR	0.056	

Furthermore, all relationships in the model are statistically significant. The Chi-square test shows a very good fit of the model to the data, with the minimum acceptable p-value normally being 0.05. According to Browne and Cudeck (1993), an RMSEA value below 0.05 indicates a close fit of the model. Jaccard and Wan (1996) argue that the model's CFI, NFI and GFI value should be above 0.90. Thus, based on the all test values, the model can be

considered acceptable. Also, each latent variable has been examined individually (see Table 3).

Table 3: Construct reliabilities, average variance extracted and Cronbach's alphas.

Latent variable	**CR**	**AVE**	**ALPHA**
DICOST	0.545	0.427	0.562
STRAON	0.880	0.680	0.880
INDICOST	0.853	0.598	0.822
POWER	0.676	0.552	0.599
SERVICE	0.798	0.633	0.802

As direct logistics costs factor have only two measures, it remain unidentified without a complete structure and it is impossible to perform factor analyses of individual latent variables. This also weakens the usability of traditional test values such as construct reliabilities (CR), average variance extracted (AVE) and Cronbach's alpha (ALPHA), therefore, the results should be evaluated primarily on the basis of the fit indexes of the full model and on the theoretical background of the measures (e.g. Juntunen, 2010; Juntunen et al., 2010; Juntunen et al., 2011a; Juntunen et al., 2011b; Juntunen et al., 2012). For the most part, the CR, AVE and APLHA values also support the good statistical fit of the model. To conclude the analyses, in accordance with our empirical evidence, we reject hypothesis one, three and four but find support for hypothesis two, five, six and seven.

DISCUSSION AND CONCLUSIONS

The purpose of this research was to study how the effective strategies and negotiation power of the public sector and the military and the relevant logistics service providers influence for indirect logistics costs via service quality and direct logistics costs. More precise, we had seven hypotheses and we rejected hypotheses one (H1 - existing strategy explains negotiation power), three (H3 - existing strategy explains experienced service level) and four (H4 - negotiation power explains direct costs). We accepted hypotheses two (H2 - existing strategy explains direct costs), five (H5 - negotiation power explains observed service quality), six (H6 - direct costs influence to indirect costs) and seven (H7 - he level of service influence to indirect costs).

Interestingly we found that contrary to the approach of classic assumption, where strategy explains negotiating power, the findings indicate that strategy and negotiating power do not have statistically significant relationship. Thus, we suggest that strategy is a long-term

concept and changes to company's positioning in the markets at the long-run while negotiation power is dependent situation at the moment of negotiation, and hence there is no direct relationship between those concepts but they need something, like current market situation, between them. Further, we found that existing strategy explains reducing direct cost but it does not explain perceived service quality. We propose that strategy influence whether buyers use expensive or cheap LSPs, but those who use cheap ones do not differentiate between poor and good quality because their strategy is to use cheapest LSP and thus they have never faced good service quality. Negotiation power does not influence for direct costs as markets defines prices and even the strongest buyers cannot bargain below market prices, however, buyers with strong bargaining power face good service as LSPs are willing to secure their relationships.

Together strategy and negotiation power affect direct costs and perceived service quality, which consequently decreases the indirect logistics costs. The most important theoretical contribution of this paper is that even it seems that Nash's (1951) famous negotiation model does not work under competitive markets with the direct market prices; it works in the long run through service quality and indirect costs. In managerial perspective, buyers of logistics services could learn from the military on how to use negotiating power and strategy to obtain the both, better service and short-term cost reductions, as together those explain reduced costs in the long run. In practice, buyers should keep a few strategic partners without bidding games but instead follow market prices and also reward the best LSPs based on good service level. This kind of deep partnership may prevent LSPs' opportunistic behaviour and hence also reduce problems described in agent theory.

At the spring of 2009 (the timing of the survey), global economic slowdown was underway, which may have affected the choices respondents made. Further research would be needed to validate the results in the wider business sector. Further, the term "logistics costs" is often problematic in survey studies, thus more research would still be necessary in future to validate instruments for enhanced measurement of logistics costs in surveys. In addition, the context of logistics has not been widely studied from a corporate-branding perspective, and there are multiple additional dimensions, such as trust and relationships, which were not taken into account in the present study. All these new concepts might offer several new avenues for logistics services research.

REFERENCES

1. Armstrong, J.S. and Overton, T.S. (1977), ''Estimating nonresponse bias in mail surveys'', Journal of Marketing Research, Vol. 14 No. 3, pp. 396-402.
2. Browne and Cudeck (1993) Alternative ways of assessing model fit. In: Bollen, K. and Long, J.S. Eds. (1993) Testing Structural Equation Models. Sage Publications Inc. Palm Springs.
3. Cox, A. (2004), The art of the possible: relationship management in power regimes and supply chains. Supply Chain Management: An International Journal, Vol. 9 No.5, pp. 346-56.
4. Chandler, A.D. (1962) Starategy and structure: Chapters in the history of American industries enterprise. MIT Press, Cambridge.

5. Dyer, J.H. and Singh, H. (1998) The relational view: Cooperative strategy and sources of interorganizational competitive advantage. The Academy of Management Review, Vol. 23, No. 4, pp. 660-679.
6. Fayezi, S., O'Loughlin, A. and Zutshi, A. (2012) Agency theory and supply chain management: a structured literature review. Supply Chain Management: An International Journal, Vol. 17 No. 5, pp. 556 - 570
7. Gentry, J. (1996), "Carrier involvement in buyer-supplier strategic partnerships". International Journal of Physical Distribution & Logistics Management, Vol. 26, No 3, pp. 14-25.
8. Gonzales, J A., Guasch, J. L. and Serebrinsky, T. (2007) Latin America: addressing high logistics costs and poor infrastructure for merchandise transportation and trade facilitation, The World Bank, August 2007.
9. Grunert, J. and Norden, L. (2012) Bargaining power and information in SME lending. Small Business Economies, Vol. 39, No. 2, pp. 401-417.
10. Jaccard, J. and Wan, C.K. (1996) Lisrel approaches to interaction effect in multiple regression, Sage Publications Inc. California.
11. Jarillo, C. J. (1988) On strategic networks. Strategic Management Journal, Vol. 9, pp.31-41.
12. Jones, G.R. and Hill, C.W. (1988) Transaction cost analysis of strategy-structure choice. Strategic Management Journal, Vol. 9, pp. 159-172.
13. Juntunen, J. (2010) Functional spin-offs in logistics service markets. International Journal of Logistics: Research and Applications, Vol. 13, No. 2, pp. 121–132.
14. Juntunen, J., Juntunen, M. and Autere, V. (2011a) Protecting Finnish defence security: a logistics challenge. International Journal of Shipping and Transport Logistics, Vol. 3, No. 3, pp. 295-311.
15. Juntunen, J., Grant, D.B. and Juga J. (2010) Short-run versus long-run trade-offs in outsourcing relationships: impacts on loyalty and switching propensity. Strategic Outsourcing: an International Journal, Vol. 3, No. 3, pp. 211-225.
16. Juntunen, J., Juntunen, M. and Autere, V. (2011b) A case study on the role of the Finnish Defence Forces in the transport sector. Journal of Military Studies, Vol. 2, No. 1, pp. 34-43.
17. Juntunen, J. and Juntunen, M. (2010) 'External economies and confidence, a way to reduce logistics costs', International Journal of Logistics Research and Applications, Vol. 13, No. 5, pp. 329-337.
18. Juntunen, J., Juntunen, M. & Autere, V. (2012) Outsourcing strategies of the security sector through acquisition procedures. International Journal of Physical Distribution & Logistics Management, Vol. 42, No. 10, pp. 931-946.

19. Jöreskog, K.G., Sörbom, D. (1993a) LISREL 8: Structural equation modelling with the SIMPLIS command language, SSI, Inc. Lincolnwood.
20. Jöreskog, K.G., Sörbom, D. (1993b) PRELIS 2: User's reference guide, SSI, Inc. Lincolnwood.
21. Jöreskog, K.G., Sörbom, D., du Toit, S. and du Toit, M. (2000) LISREL 8: new statistical features, SSI, Inc. Lincolnwood.
22. Langley, C.J. Jr. and Holcomb, M.C. (1992) Creating logistics customer value. Journal of Business Logistics, Vol. 13, No 2, pp. 1-27.

23. Larson, P. D. (2005) A Note on mail surveys and response rates in logistics research. Journal of Business Logistics, Vol. 26, No. 2, pp. 211-222.
24. Mentzer, J.T., DeWitt, W., Keebler, J.S., Min, S., Nix, N.W., Smith, C.D. and Zacharia, Z.G. (2001) Defining supply chain management. Journal of Business Logistics, Vol. 22, No. 2, pp. 1-25.
25. Nash, J. (1951) Non-cooperative games. The Annals of Mathematics, 2nd ser., 54(2), 286-295.
26. Porter, M. E. (1980) Competitive strategy. Free Press, New York.
27. Smith, A. (1776) Of the discouragement of agriculture in the ancient state of Europe after the fall of the Roman empire. In: Jean-Jacques Laffont. (ed) (2003) The principal agent model: The economic theory of incentives. Edward Elgar Publishing Limited, Cheltenham.
28. Solakivi, T., Ojala, L., Töyli, J., Hälinen, H.-M., Lorentz, H., Rantasila, K. and Naula, T. (2009) Finland state of logistics. Publications of the Ministry of Transport and Communications 21/2009. Helsinki.
29. Song, Y.-Y., Maher, T.E., Nicholson, J.D. and Gurney, N.P. (2000) Strategic alliances in logistics outsourcing. Asia Pacific Journal of Marketing and Logistics, Vol. 12, No. 4, pp. 3 – 21.
30. Tirole, J. (1999) Incomplete contracts: Where do we stand? Econometrica, Vol. 67, No. 4, pp. 741-781.
31. Willcocks, L.P., Lacity, M.C. and Kern, T. (1999) Risk mitigation in IT outsourcing strategy revised: longitudinal case research at LISA. Journal of Strategic Information Systems, Vol. 8, pp. 285-314.
32. Williamson, O.E. (1971) The vertical integration of production: Market failure considerations. The American Economic Review, Vol. 61, No. 2, pp. 112-123.

Appendix 1. Descriptive statistics.

Group		ologstra	stratuse	clearstr	costware	costtran	costper	costlog	schedule	capacity	service	price	slave	takeprof
Defence	Mean	3,17	3,64	3,20	4.21	3.95	3.26	3.79	3.00	2.64	2.46	4.45	4.40	4.49
	Std. Deviation	2,369	1,979	1,939	1.510	1.559	1.589	1.562	1.026	1.038	1.022	1.484	1.446	1.355
Public	Mean	4,86	4,04	4,624	3.04	3.09	2.96	2.96	3.04	2.71	2.79	4.56	4.36	4.56
	Std. Deviation	2,0484	1,7774	1,821	1.397	1.535	1.296	.878	1.042	1.160	.977	1.417	1.254	1.446
Private	Mean	3,04	3,31	3,19	3.42	2.75	2.47	2.39	2.27	2.28	2.33	4.12	4.36	5.07
	Std. Deviation	2,054	1,917	2,009	1.689	1.385	1.255	1.193	.898	.966	.975	1.745	1.823	1.589
Total	Mean	3,45	3,56	3,48	3.59	3.16	2.80	2.91	2.63	2.47	2.45	4.30	4.37	4.80
	Std. Deviation	2,259	1,918	2,021	1.634	1.546	1.405	1.400	1.028	1.036	.997	1.613	1.611	1.511
	ANOVA	0.001	0.247	0.003	0.11	0.000	0.017	0.000	0.000	0.105	0.148	0.391	0.992	0.104
ANOVA Military/Private		0.378	0.754	0.991	0.018	0.000	0.006	0.000	0.000	0.077	0.507	0.312	0.911	0.056

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

DO TRAINING FUNDS RAISE THE PACE OF TRAINING? THE CASE OF MAURITIUS

Oluyemisi Kuku, IFPRI

Peter F. Orazem, Iowa State University

SawkutRojid, The World Bank

Milan Vodopivec, University of Primorska and International School for Social and Business Studies, Celje

ABSTRACT

Many developing countries have tried to increase firm provision of training by providing subsidies funded by taxes proportional to the firm's wage bill. These training funds, however,may backfire if the adverse effect of the tax on training incentives outweighs the positive effects of the subsidy. We show that the value of these training funds depends critically on the extent to which firms are liquidity constrained. If the effective firm discount rate is low, the disincentives outweigh the benefits. Using an administrative dataset on the Mauritius training fund, we show that larger, high-wage and more capital intensive firms are the most likely to offer to training without the subsidy, but that the subsidy creates an increased incentives for small firms to train. As a result, the largest firms pay more in taxes than they gain in subsidies while the smallest firms receive more benefits than they pay in taxes. Consequently, the program shifts net training investments away from the firms that would normally have the greatest return from training and toward smaller firms that would normally have the lowest return from training. It is doubtful that the program actually raises the incidence of training overall.

JEL: M53; O15; O2; O55

KEYWORDS: training, general skills, firm-specific skills, training fund, externality, cross-subsidy, tax

corresponding author: Peter F. Orazem, Department of Economics, Iowa State University, Ames, IA, 50011-1070, USA. pfo@iastate.edu (515) 294 8656.

INTRODUCTION

One of the most intensively studied issues in labor economics over the past twenty years is whether active labor market policies improve economic outcomes. While the earliest studies reviewed by Heckman et al (1999) generally failed to find positive results, more recent reviews by Betcherman et al (2004) and Card et al (2010) have found more supportive evidence for the most common intervention, training.[1] The most successful training programs in both developed and developing countries appear to focus on on–the-job or firm-based training.

A common funding source for the training programs is to tax the firms that are also targeted for training programs. The earliest programs in Belgium, Cyprus, Denmark, France and the Netherlands began as narrowly focused sectoral training programs in the 1960s and 1970s. All represented some form of partnership between unions and firms in a specific sector accompanied by government coordination. The rationale for these funds is a presumption that firms under-invest in training in the absence of government intervention. The most common argument is that training increases the value of a worker in many firms and not just one, meaning that the firm that invests in training risks losing the investment if the worker is hired away by another firm. Using Becker's (1993) terminology, the greater the share of the training that is general rather than firm-specific, the greater the incentive for firms to free ride on the other firms' investment by raiding their trained workers rather than investing directly. This rationale makes the most sense when there are many firms using similar skills such as in a single industrial sector. The sectoral training agreements common in Europe allow all the firms to agree to pay equally for training through the payroll tax and then share in the benefits, forcing all firms to internalize the training externality.

In developing countries, it is more common for central governments to impose training fund programs across sectors without the explicit participation by labor collectives or firms.[2] These policies have been most popular in Latin America and Sub-Saharan Africa who each represent 27% of the total programs reviewed by Johanson (2009). Because these programs are not focused on a common set of skills, they invariably involve cross–subsidization of training intensive firms by others and so the justification for the European training programs does not hold. Nevertheless, these programs could address a second possible externality if there are returns to scale in the provision of generally valued skills. By pooling funds through the tax system and coordinating training through approved providers or direct government provision, the government can lower the unit cost of training. Absent that coordination, individual firms would end up paying much higher prices per unit of training and many would simply forego undertaking that expense.

[1] Classroom and workplace training represent 42% of all active labor market policy in developed countries (Card et al , 2010, table 3) and in developing and transition economies (Betchermanetal, 2004, table 4).
[2] See CEDEFOP(2008) for a summary of European training fund programs.

The rationale for government intervention in the provision of training is much weaker if the skills are specific to a single firm.[3]There is no incentive for other firms to poach trained workers whose skills have no added value outside the firm that provided the training, and so the free-rider problem does not exist. Because the skills are unique, there are no returns to scale in the provision of training. The only plausible rationale remaining for government intervention is that firms face liquidity constraints that prevent them from investing efficiently in their workers. In that case, it is possible that the public training subsidy will cause firms to invest efficiently in their workers.

Even if these market failures exist, it is not clear that they are sufficiently large to outweigh the inefficiencies caused by a payroll tax that lowers the return to investment if the tax is borne by the firm, or returns to labor supply if the tax is borne by the worker. Additionally, costs associated with collecting taxes and administering the training funds are unnecessary if the firms would have invested in training without the program. However, past studies have not examined whether these training fund programs are cost effective. Johanson's (2009) comprehensive review of 62 national training funds concludes that despite vast amounts spent on training, evaluation has been largely anecdotal and limited to assessments of outcomes against targeted levels. This is particularly true in developing countries where studies have yet to establish that firms face lower marginal costs of training or increase their training investments as a result of the training funds.

The need for evaluations of training funds is particularly urgent in Sub-Saharan Africa which faces the need to accommodate the fastest growing labor force in the world.[4] There are numerous areas where public dollars could be used to enhance job growth, and so investments in training carry a high opportunity cost. When asked what factors hinder business growth, African firms rank insufficient job skills as 11th most important, behind such factors as transportation, access to electricity, input costs, access to financing, and political instability. It is not obvious that training is the best use of scarce resources.

This paper use the Mauritius Training Fund as a case study of the performance of training funds. We examine whether the firms that engage in training are those that would be predicted to train in a standard Becker(1993) model of training or if the training fund alters the incentives to train. Next, we examine the implied patterns of cross-subsidization from the firms paying into the system to the firms receiving the training subsidies. That analysis shows which industries are taxed in order to subsidize others and whether small firms subsidize large firms or vice versa. Finally, we examine whether there is any evidence that the training raises labor productivity.

We find thatthe training subsidy does increases training for the smallest firms that would not otherwise train without the subsidy. However, large, capital-intensive, high-wage firms that would be expected to have the greatest incentive to train without the subsidy end up paying more in taxes than they receive in subsidies. Furthermore, the subsidies focus on classroom training

[3] Even with general skills, the firm might still provide training without government intervention if informationa asymmetries or other labor market rigidities make workers immobile (Acemoglu and Pischke, 1998, 1999).
[4] Statistics cited here are from McKinsey and Company (2012).

that has the lowest returns rather than on in-house training that has the highest returns in evaluations. We conclude that in Mauritius, for medium and large firms, the adverse effect of the tax on training outweighs the incentive effect of the subsidies. As a result, the training fund may well lower rather than raise the incidence of training in the country.

THE MAURITIUS TRAINING FUND

Following the Human Resource Development Act of 2003, allregistered firms in Mauritius are required to pay a training levy. The tax is proportional to the firm's total base wage bill, the aggregate of wages paid workers excluding overtime, bonus and benefits. The government then uses this money to reimburse firms for a portion of their training costs. In principle, firms can be reimbursed up to ten times the tax they pay into the training fund. The reimbursement rate falls as the total expenditure on training increases, but the reimbursement can still be as high as five times the training levy paid for the most training intensive firms.

The stated objectives of the training fund are to (i) promote human resource development in line with national economic and social objectives, (ii) stimulate a culture of training and lifelong learning at the individual, organizational and national levels for employability and increasing productivity; and (iii) provide the necessary human resource thrust for successful transformation of the economy into a Knowledge Economy. Only the last of these is sufficiently concrete to enable an evaluation, suggesting that the program should atypically induce training in the technology sector or other sectors that use information technologies.

Table 1 presents summary information for firm training using our industry and firm size cells. In all 9 sectors, training intensity rises with firm size. Propensity to train varies by sector between 6-10% for the smallest firms to 23-47% for the largest firms. Consistent with the stated objective to encourage the growth of the knowledge economy, training intensity is highest in Information Technology and Finance.

Nevertheless, one might expect that such a policy should have inducedmost firms to invest at least modestly in training every year, and yet only 9% participated in FY2008. One problem is that the training subsidy requires substantial paperwork, use of approved trainers, and prior approval of the training curriculum. The training is also subject to minimum participation of 10 workers if the training is offered in the workplace. These restrictions clearly limit the potential participation of smaller firms that may not have enough workers to train or sufficient expertise to manage the paperwork, consistent with the pattern of training by firm size found in Table 1.

However, the training fund is not necessarily geared to benefit large firms either. The program focuses on reimbursement for formal training with greater restrictions on training offered in firms rather than classrooms. However, the most common forms of training in Mauritius as in other countries are on-the-job and/or in house training (see Figure 1). Training provided by institutions has been declining in importance with firms complaining the skills are too generic to meet their needs. Other types of training such as reimbursement for tuition from overseas institutions, for domestic Master's training, or for bringing in a foreign expert represent a small

share of disbursements. And yet it is on-the-job training and in-house training that have been singled out as particularly effective in evaluations conducted in developed, transition, and Latin American economies (Betcherman et al, 2004).

If the training fund is eliminating a market failure due to liquidity constraints that constrain firm incentives to train, one would expect the program would have broad participation. Instead, Figure 2 shows that taxes levied on firms typically exceeded the training grants disbursed, so much so that the training levy was cut in half in FY2009. Only 9% of the firms provided training in the period we examine and the World Bank (2011) estimates that only 20% of firms have provided formal training that could qualify for reimbursement in the past. This level of training is below the 30% training incidence for Sub-Saharan Africa reported by Johanson (2009).

Training funds have been underutilized in other developing countries as well, causing the funds to be repurposed to other uses (eg Costa Rica, Gabon , Togo, and Zimbabwe). In some places, the funds were used to create a large government training bureaucracy rather than assisting firms (Colombia, Venezuela). In Mauritius, the number of private training institutions is increasing even as their share of training provision is declining and firms are complaining about their services.

Even if the Mauritius training fund is not fully utilized, it may still increase the propensity to train. To assess that, we need to establish a model of expected training in the absence of the government program. We turn to that next.

THEORY

Becker's (1993) theory of on-the-job training provides a useful framework for our evaluation, allowing us to predict which firms would participate. A firm's incentive to invest in training depends on the anticipated returns to training compared to the opportunity costs and direct costs of the training. Let $T_i$be a dummy variable that indicates whether the i^{th}firm invests in training. Training will occur if the expected net return from trainingR_i is positive. Probability that firm i trains is

$$\Pr(T_i = 1) = \Pr(R_i > 0) \quad (1)$$

R_i will take the form

$$R_i = N_i(\pi - \tau)[(\sum_{t=1}^{M}\left(\frac{1}{1+r}\right)^t)(T_i W_{it}^T + (1 - T_i)W_0^O)] + N_i(\pi - \tau)(1 - T_i)W_0^O$$

$$-N_i T_i W_0^O(1 + \tau) + N_i T_i(S_{i0}^T + \varepsilon_i^T - C_{i0}^T) \quad (2)$$

where$M$ represents the firm's time horizon over which it anticipates employing N_i workers. The firm earns a markup π on the wages it pays. The firm's cost of labor includes a tax rate, τ. The

firm must pay taxes into the training fund, whether or not it trains. If the firm trains, it pays the post-training wage, W_{it}^T for all $t>0$. If the firm does not train, it pays workers a constant base wage,W_0^O for all M periods. If the firm trains in period 0, it gets no output in period 0 but pays out the worker's opportunity wage along with the tax levy, $W_0^O(1+\tau)$. The remaining terms incorporate firm-specific costs and benefits from training, where the direct cost of training is C_{i0}^T, thetraining subsidy from the government is S_{i0}^T, and the firm also earns an unobservable positive or negative incremental per worker return to training, ε_i^T, that is known to the firm but not the econometrician. The marginal return to training is

$$\frac{\partial R_i}{\partial T_i} = N_i(\pi-\tau)[(\sum_{t=1}^{M}(\frac{1}{1+r})^t)(W_{it}^T - W_0^O)] - N_i(\pi+1)W_0^O + N_i(S_{i0}^T + \varepsilon_i^T - C_{i0}^T) \gtrless 0 \qquad (3)$$

If $\frac{\partial R_i}{\partial T_i} > 0$, the firm should invest in training. If negative, the firm will not train.Factors that make $\frac{\partial R_i}{\partial T_i}$ more positive will raise the probability of training. To begin, we assume that $W_t^T > W_0^O$ so that training raise worker productivity.[5] It is also requires that $\pi > \tau$ so that the profit from raising a worker's marginal product exceeds the taxes that would be paid on the resulting wage increases. $\frac{\partial R_i}{\partial T_i}$ becomes more positive and so likelihood of training increases with increases in the mark-up over wages π, increases in the training subsidy S_{i0}^T, increases in the productivity of training as proxied by the wage gap $(W_{it}^T - W_0^O)$, and increases in the unobserved profitability from training ε_i^T. The probability of training also increases with smaller tax levy imposed on the induced increase in wages, τ;with smaller interest rates that reduce the present value of future returns to training, r;and with smaller training costs C_{i0}^T.

The theory demonstrates the potential problem with training funds that generate revenues through taxes on wages. Training will raise wages and so the training fund policy taxes the return on training even as it lowers training costs. There is no guarantee that the policy will raise aggregate training in the economy.The training fund is most effective when firm's face liquidity constraints as represented by high interest rates r. The reason is that $\frac{\partial^2(\frac{\partial R_i}{\partial T_i})}{\partial \tau \partial r} > 0$: the tax does not affect the present value of training as much when the firm is discounting the future more heavily. However, if the constraints on liquidity are modest, the tax levy becomes more costly and the likelihood that the training fund increases probability of training diminsishes.

If the costs of training $C_{i0}^T$and the subsidy $S_{i0}^T$are constant and do not vary with firm size, equation (3) implies that there will be no size-bias in the incidence of training. In other words, C_{i0}^T and/or S_{i0}^T must be nonlinear in N to generate the size-bias we observe in the training data. Either or both of the following specifications could generate the rising incidence of training as firm size increases

[5] Training cannot lower productivity from the base level, but it is possible that the training adds no value so that $W_t^T = W_0^O$. In that case, the only reason the firm would engage in training is that the subsidy S_{i0}^T is so large that it fully compensates the firm for the lost production while the firm trains.

$$C_{i0}^T = \frac{c_0}{N_i} + C(N_i);\ C'(N_i) \leq 0 \quad (4A)$$

$$S_{i0}^T = S(N_i); S'(N_i) \geq 0 \quad (4B)$$

Equation (4A) suggests that firms face a fixed cost of participation due to paperwork involved in applying or validating the training and providing the required accounting to the government. Average cost of training falls with the size of the firm because these fixed costs are spread over a larger number of trainees and also because there may be increasing returns to training such that $C'<0$.[6] Even if the marginal cost of training is constant as N_i increases, there will be falling average cost of training as firm size rises. As for $S'(N_i) \geq 0$, the requirement that the firm have a minimum number of trainees to qualify for a subsidy generates a subsidy that increases in N.[7]

The theory suggests that there should be rising incidence of training as firms increase in size, as the subsidy increases in value, as training costs decrease, and as wages rise relative to the untrained wage. We test all these propositions in the next section.

EMPIRICAL SPECIFICATION

The theory suggests two specifications. The first treats training as a dichotomous variable. Using (3), we infer that T_i=1 if

$$I = (\pi - \tau)[(\sum_{t=1}^{M} (\frac{1}{1+r})^t)(W_{it}^T - W_0^O)] - (\pi + 1)W_0^O + S_{i0}^T - C_{i0}^T > -\varepsilon_i^T$$

If we approximate the index function $I(\cdot)$ by its reduced form, we have

T_i=1 if $I(\pi, W_{it}^T, W_0^O, \tau, C_{i0}^T, S_{i0}^T, N_i) > -\varepsilon_i^T$
T_i=0 otherwise (5)

If the unobserved return to training $\varepsilon_i^T \sim N(0,1)$, then (5) defines a probit equation. If instead, we have a continuous measure of training intensity, as for example if T_i is measured as the training cost as a fraction of total compensation, then the reduced form will be

$$T_i = f(\pi, W_{it}^T, W_0^O, \tau, C_{i0}^T, S_{i0}^T, N_i, \varepsilon_i^T) \quad (6)$$

[6] Black et al (1999) show that there are economies of scale in training that favor large firms.
[7] We can redefine T_i as training intensity such that $0 \leq T_i \leq 1$. That would make sense, for example, if firms invested between 0 and 100% of the workers time in the first period in training. In that case, firms that train will invest optimally by setting $\frac{\partial R_i}{\partial T_i} = 0$ in (3). For an interior solution, firms must face increasing costs of training or decreasing returns to training.

which we can approximate using ordinary least squares.

In our application, the training levy tax rate τ is the same for all firms and we assume the markup over the wage π is also fixed in expectation across firms. The base wage W_0^O should also be the same across firms in the same industry. Mauritius is a small island economy, and so it is logical to assume that worker mobility will equalize sectoral base wages throughout the island. Consequently, sectoral variation in W_0^O can be controlled using sector-specific dummy variables.The remaining observable explanatory variables in (5) and (6) that vary across firms include W_{it}^T, C_{i0}^T, S_{i0}^T, andN_i.

DATA

Our data source is an administrative data set that includes training levy, firm size and firm sector information for the universe of all registered firms in Mauritius in 2007. The data set also includes accounting data for about 30 % of the firms in 2007. The data are sufficient to allow us to approximate the information we need to evaluate the determinants of training in Mauritius.

Endogenous Variables

We have two measures of $T_i$available in the data set:

Training Incidence:A dummy variable equal to 1 if the firm trained in 2007.Only 9% of the firms reported training expenditures in 2007.

Training Intensity: The log of total training expenditures per employee in 2007. This measure presumes that when a large firm only trains a single worker, that represents a less intensive training investment than if a small firm trains its lone employee.

Exogenous Variables

The key regressors we require are measures of firm wages, training costs and the anticipated subsidy. The Mauritius administrative data did not include individual wages or the wage bill for the firm. However, it did include a measure of the aggregate training levy paid by the firm. Regardless of whether they train or not, each firm pays the training levy used to subsidize firm training. The levy is proportional to the firm's base wage bill which is total compensation excluding overtime, bonuses and benefits. That means that the training levy $\tau N_i \overline{W_i}$ where τ is the tax rate, N_i is the number of firm employees, and $\overline{W_i}$ is the average wage in the firm in year *t*. In log form, $\ln\left(\frac{\tau N_i \overline{W_i}}{N_i}\right) = \ln(\tau \overline{W_i}) = \ln(\tau) + \ln(\overline{W_i})$. In regressions, the effect of the tax rate will be captured in the constant term. Because sector dummies controls for variation in W_0^O, the coefficient on $\ln(\tau \overline{W_i})$is interpretable as the elasticity of training with respect to $(W_i^T - W_0^O)$, a proxy of the anticipated return to training.

The Mauritius administrative data provide information on the total cost of training including firm payments and the government subsidy for all firms that participate in the program. We compute an average cost per hour of training by dividing firm payments plus subsidies divided by the total hours of training across all trainees in the firm. To create an expected cost of training for each firm, we divided the data into 9 industrial sectors. Each sector was further subdivided into the three firm size groups defined in Table 1. The average training cost per hour for participating firms in each of the 27 cells is used as the expected training cost, C_{i0}^{T}. We use the log form of this measure.

We use a similar strategy to estimate the expected subsidy in each of the 27 cells. For each company receiving a subsidy in 2007, we compute the ratio of training grants received by the company to the firm's total expenditures on training. A small fraction of firms had ratios greater than 1. Since firms should only get back a fraction of their training costs, we expect this value to be less than one, and therefore set any values greater than one to one. Expected subsidy is the mean subsidy per across all training firms of this measure by sector and firmsize cell. Because these values vary between zero and one we left these as rates rather than converting to logs.[8]

A large literature suggests that there is more need for training in larger firms with more complex production processes and internal labor markets.[9]In addition, returns to scale in training may give larger firms a cost advantage in training provision (Black et al, 1999). Our firm size measure is total employment N_{i0}in log form.

Capital and skill are presumed to be complements in production, and so training is believed to be most important in firms with more complex production processes. Therefore, we include a measure of firm capital $K_{io}$to control for heterogeneity in training needs across firms. We only have capital asset measures for 4013 firms and so we use the log of the mean value per firm in each sector and firmsize cell as the common measure for all firms in the cell.

[8] As many of the values are close to zero, taking the log led to very large negative values for some and values close to zero for others, and so the log tended to exaggerate outliers. In addition, because for numbers close to zero, $ln(1+x)\rightarrow x$, leaving these values in rates did not depart much from the log transformation applied to the other measures.

[9]Doeringer and Piore (1985) showed how firm size led to the creation of internal labor markets, increased firm training, and lower worker mobility. Oi and Idson's (1999) review of the literature shows that worker mobility is inversely related to firm size.. Black et al (1999) show that the incidence of training rises with firm size because large firms have a cost advantage in offering training. Acemoglu and Pischke (1998, 1999) argue that asymmetric information on worker productivity leads to worker immobility that increases firm incentive to train. The asymmetric information they discuss is likely to be more important in large firms.

RESULTS

Training incidence and intensity

We report two specifications of the training equation inTable 2.[10] The results are quite consistent with one another, whether training is measured as a dichotomous variable or as a per worker investment. The results are also consistent with the theoretical predictions implied by equation (3): factors that raise the expected net return on training increase the likelihood that the firm invests. Noting that sector-specific dummy variables are used to fix the value of the base wage W_0^O, a 10% increase in the post-training wage relative to the base wage raises the probability of training by 4.8%. Recall that in the Becker framework, the firm's return to training is proportional to $(W_{it}^T - W_0^O)$, and so higher worker returns in the form of higher wages signal that the firm is making a higher return as well.

The other factors that should raise the returns to training also increase the incentives to train. Firm size and capital intensity both have strong positive effects on firm training probability and intensity. Ten percent increases in firm size and capital stock both raise the probability of offering training by 1%.All of these findings are consistent with a standard model of firm investment in on-the-job training.

Interestingly, expected training costs do not significantly affect the probability of training. That suggests that expected training costs are not an impediment to training, casting doubt on the justification of the training fund.

And yet the probability of training is quite sensitive to the expected subsidy in their sector/firm size cell. The large elasticity implies that relatively small subsidies greatly expand interest in training, holding constant factors that should increase returns to training. On the margin, firms that would not have invested in training without the training fund do invest with the promise of training subsidies. Without the subsidy, training would be concentrated in the largest, capital intensive firms with the most rapidly rising wage profiles.

None of the industry dummy variables are statistically significant individually or jointly. Outside the incentive offered by the subsidy, there is no evidence that the government favors one sector over another. Because training was supposed to target information technologies, these results suggest that the apparent bias toward information technology firms we observed in Table 1 exists because those firms have a greater need to train even without the training fund and not because the training fund is atypically raising training incentives for information technology firms.

[10] The goodness of fit is low, but our dependent variable is whether the firm invested in training in one particular 12 month period rather than the more theoretically appropriate measure which would be whether the firm ever engaged in training. We note that 20% of Mauritius firms train, but only 9% of them trained during our one-year window, an indication of considerable noise in the dependent variable. However, with the huge sample size, we were able to derive reasonable coefficients despite the noisy training indicators.

The question remains as to whether the training fund increases the incidence of training through the subsidy or lowers the incidence of training because of the tax. The consistent pattern of tax levy receipts exceeding disbursements seen in Figure 2 suggests that the nete effect may be to reduce training. We add additional evidence to that effect next.

Cross-subsidization in the Mauritius training fund

While the evidence from Table 2 suggests that firms would respond elastically to the issuance of training subsidies if the program were made more easily available, we have not documented whether the training fund reallocates from some firms and toward others. Table 3 divides the firms into the 27 firm size by industry cells. For each cell, we compute the total training levy paid by firms in the cell, the total subsidies received by firms in the cell, and the ratio of the benefits received to the taxes paid. Ratios above one indicate that the cell group received more in benefits than it paid in taxes while ratios less than one indicate the cell paid more in taxes than it received in training subsidies.[11]We also report the fraction of firms in each cell that engaged in training.

The results show a surprising result: the pattern of cross subsidization is from large to small firms. While small firms are not likely to train in the absence of the training fund, small firms receive more in training subsidies than they pay in taxes. The cross subsidization from large to small firms occurs in every sector. The largest ratios are not the targeted information sectors, but rather agriculture, wholesale and retail trade and transportation.

Moving up the size distribution, intermediate sized firms are more likely than small firms to invest in training, but only in information technology is the ratio of subsidy to training levy larger than it was for the smallest firm. Finance, hotels and information technology are the three sectors that received more in subsidy than they paid in taxes.

Curiously, it is the largest firms that should have the greatest incentive to train without the subsidy, but they are atypically taxed to subsidize the firms with the least natural inclination to train. In every sector but Finance, the ratio of benefits to taxes paid is lower for the largest firms than for the intermediate or small firms. Yet it is these largest firms that have the highest propensity to train in every sector.

Combining the inference derived from Tables 2 and 3, it seems clear that the Mauritius training fund alters firm incentives to train but it does so by taxing the firms with the comparative advantage in training in order to subsidize the firms with the least to gain from training. Coupled with the finding in Figure 2 that the training fund takes in more in taxes than it pays out in subsidies, it seems that the net effect may well be to lower the returns to training for large firms through the tax more than it lowers the marginal cost of training as would be the case if the presumed liquidity constraints on large firms were not severe. It does raise the incidence of training in the smallest firms that may indeed face liquidity constraints on training. Whether this

[11] We also computed cell values in per worker and per firm terms. The ratios were virtually identical.

is a general pattern of training funds in developing countries that tax firm returns to training in order to generate funds used for training subsidies is unclear, but the Mauritian policy is not dissimilar to the most commonly used training funds in Africa and Latin America. Our results suggest that the policy may be counter-productive.

Training effects on firm output and growth

We have only limited ability to examine whether training actually raise labor productivity, and so we offer these estimates as suggestive. Training intensive firms should have higher current productivity and should have greater potential for future growth. We embed the firm's training investment in a standard Cobb Douglas production function.

$$lnQ_{it} = \alpha_0 + \alpha_K lnK_{it} + \alpha_N lnN_{it} + \alpha_T lnT_i + X_{it}'\beta + \varepsilon_{it} \quad (7)$$

Our measure of output is total revenue reported in 2007. For this application, we need to use the actual capital measure and so we can only estimate the production function for about one-third of the firms. For this application, we use the continuous measure of training,lnT_i, as defined by the right-hand columns in Table 2. Note that we need to use predicted values of training to generate an expected level of training given the firm's observable attributes. The reason is that any one year's training level measures the long-run level of training investment with considerable error due to random labor turnover that changes the fraction of employees requiring training from one year to the next. The predicted training level will reflect the long term relationships between firm attributes, taxes subsidies, and propensities to train.

Training may not just change current output but it may change the pace of firm growth. If true, then the training effect may be better captured by equations of the form

$$ln\frac{Q_{it+1}}{Q_{it}} = \gamma_0 + \gamma_K lnK_{it} + \gamma_N lnN_{it} + \gamma_T lnT_i + X_{it}'\theta + \epsilon_{it} \quad (8)$$

Equation (8)is estimated using two alternative outcome measures:

Log Wage Bill Growth:The difference in logarithms of the total levy paid between 2007 and 2008 will be proportional to the growth in the wage bill.We use 2007 measures of capital, labor and training as regressors.

Log Employment Growth: The difference in logarithms of the number of employees between 2007 and 2008.

We report these regressions in Table 4. The production function estimates suggest that a 10 percent increase in training intensity increases current output by4.2 percent.However, training does not appear to affect growth in the wage bill or employment, suggesting that training does not alter the growth prospects of firms. More definitive conclusions would require a longer longitudinal record on training and nontraining firms to see if our cross-sectional production function estimates hold up over longer horizons.However, these results suggest that the benefits

of the training are largely confined to the firm providing the training and that the program does not generate positive externalities that spread to other firms not receiving training subsidies that might raise the growth rate of the economy as a whole.

CONCLUSIONS AND RECOMMENDATIONS

The Mauritius training program is aimed at encouraging firm training by imposing a levy on all firms and then reimbursing them a percentage of the expenses paid for some types of training. The levy is based on the firm's wage bill, meaning that the largest taxes are paid by firms with the most employees and/or that pay the highest wages, the firms that have the highest return to training in the absence of the program. The tax lowers incentive to train, even as the subsidy raises the incentive to train. Our results show that the factors that should increase the incentives to train in the absence of the training fund behave as expected and that training costs do not serve as an impediment to training. While the subsidies do raise the likelihood of training for firms that would not have trained otherwise, the greatest effect is on the smallest firms. As a result, the program disproportionately taxes the largest and most capital intensive firms that would be most likely to train without the program, and disproportionately benefits the smallest firms that would have the least incentives to train.

One problem is that the training subsidies target general skills such as those provided by domestic of foreign training firms and graduate programs and not training provided on-the-job or in-house. Evaluations in both developed and developing countries have found greater benefits from on-the-job training rather than the classroom training favored by the Mauritius training fund.

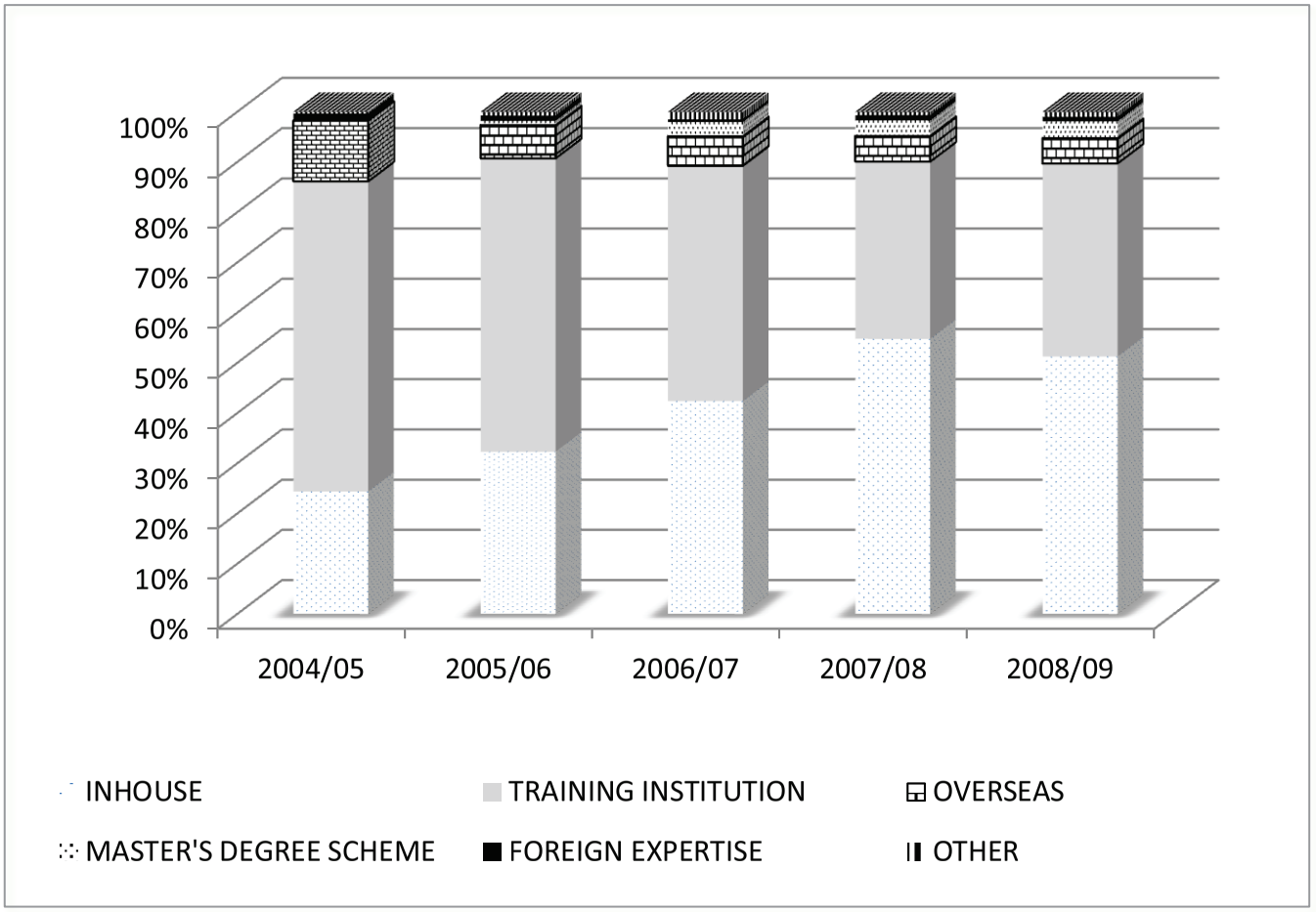
If the performance of the training fund is to be improved, it should target the type of training that is most useful in its absence – training specific to the firm. If more general skills are to be offered, it may be useful to follow the sectoral training model used in Europe in which the firms within a specific sector pool resources to invest in skills uniquely required by firms in the sector with the government serving in a coordinating role.

However, another option is to eliminate the training fund program altogether. As shown in the theory, the training fund is most effective when there are liquidity constraints on firms. There is no evidence that the largest and most capital intensive firms in Mauritius suffer from liquidity constraints, and as a result, theory predicts that the negative incentive effects of the tax outweigh the positive effects of the subsidy. As a result, the training fund may well lower the overall incidence of training, consistent with the result in Figure 2 that the program takes in more in taxes than in pays out in subsidies. It is virtually certain that there are alternate uses of these public funds that would produce a better return.

REFERENCES

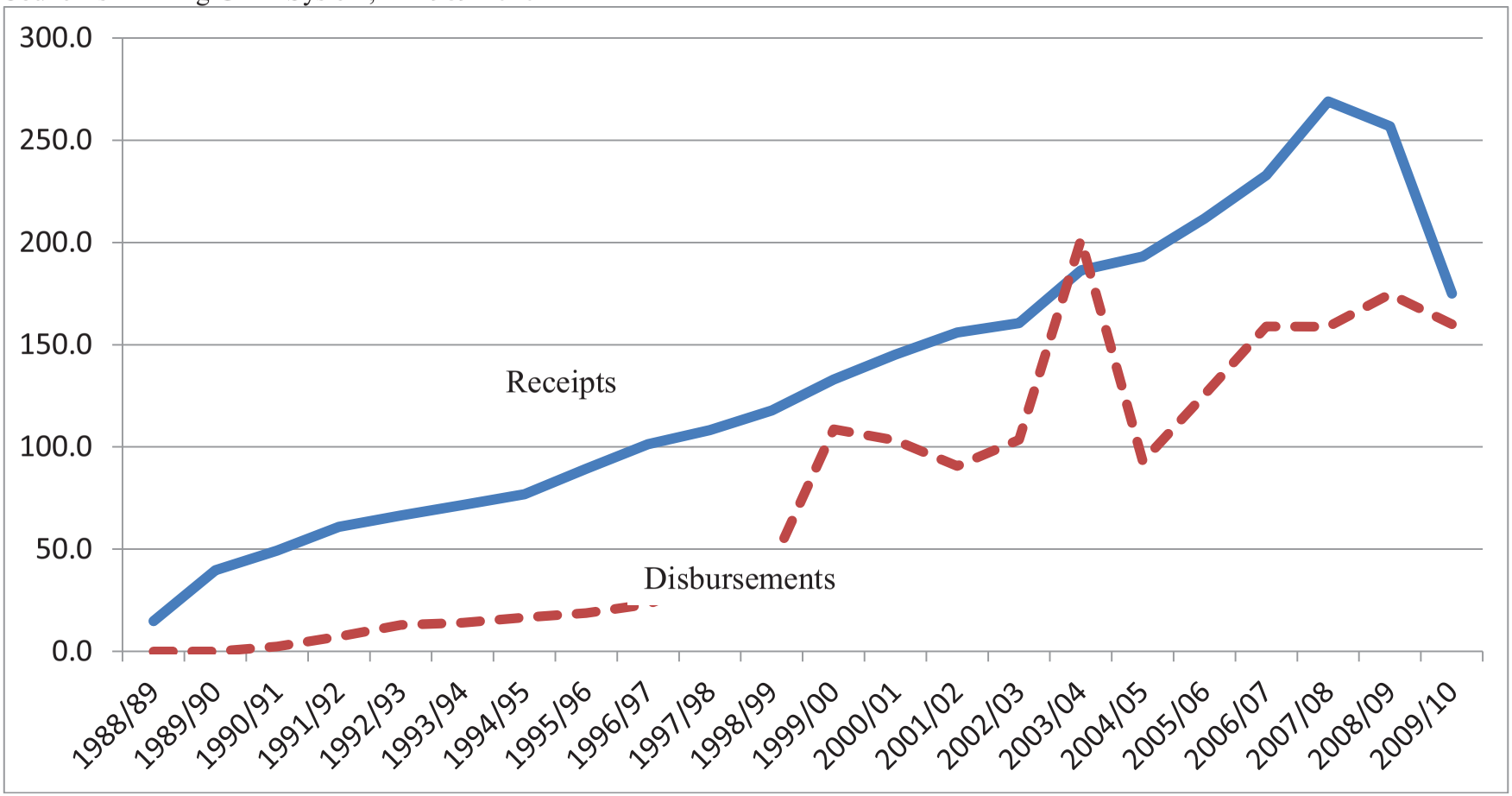
1. Acemoglu, Daron and Jorn-Steffen Pischke. 1998. "Why Do Firms Train? Theory and Evidence."The Quarterly Journal of Economics 113(1): 79-119.
2. Acemoglu, Daron and Jorn-Steffen Pischke. 1999. Beyond Becker: Training in Imperfect Labour Markets." The Economic Journal 109(453): F112-F142.
3. Becker, Gary S. 1993. Human Capital: A Theoretical Analysis with Special Reference to Education, 3rd Edition. Chicago: University of Chicago Press.
4. Betcherman, Gordon, Karina Olivas, and Amit Dar. 2004. "Impacts of Active Labor Market Programs: New Evidence from Evaluations with Particular Attention to Developing and Transition Countries." Social Protection Discussion Paper Series #0402.The World Bank.
5. Black, Dan A., Brett J. Noel and Zheng Wang. 1999. "On-the-Job Training, Establishment Size, and Firm Size: Evidence for Economies of Scale in the Production of Human Capital." Southern Economic Journal 66(1): 82-100.
6. Card, David, JochenKluve and Andrea Weber. 2010. "Active Labour Market Policy Evaluations: A Meta Analysis." The Economic Journal 120(548):F452-F477.
7. (CEDEFOP) European Centre for the Development of Vocational Training. 2008. Sectoral Training Funds in Europe. Luxembourg: Office for Official Publications of the European Communities.
8. Doeringer, Peter B. and Michael J. Piore. 1985. Internal Labor Markets and Manpower Analysis Armonk, NY: M.E. Sharpe.
9. Heckman, James J., Robert J. Lalonde and Jeffrey A. Smith.1999. "The Economics and Econometrics of Active Labor Market Programs." in Ashenfelter and Card eds. Handbook of Labor Economics Vol 3A, Chapter 31. Amsterdam: Elsevier Science, B.V.
10. Johanson, Richard. 2009.A Review of National Training Funds. World Bank SP Discussion Paper 52187.(November).
11. McKinsey and Company. 2012. Africa at Work: Job Creation and Inclusive Growth (August).
12. Oi, Walter y. and Todd L. Idson. 1999. "Firm Size and Wages." ." in Ashenfelter and Card eds. Handbook of Labor Economics Vol 3B, Chapter 33.Amsterdam: Elsevier Science, B.V.
13. World Bank. 2011. Skills Development and Technology Absorption in Mauritius. Report No. 62213-MU.(May).

Figure 1: Distribution of training by type and location of trainer, Mauritius Training Fund, FY2005-2009



Source: Authors' compilation of data provided by the Mauritius Human Resource Development Council.

Figure 2: Tax Levy Receipts and Disbursements (in million Mauritian rupees) of the Mauritius Human Resource Development Council's Training Grant System, FY1989-2010



Source: Authors' compilation of data provided by the Mauritius Human Resource Development Council.

Table 1: Averages of firm propensity to train by sector and firm size, Mauritius, 2007/2008.

Sector	Small 1-9 workers	Medium 10-50 workers	Large >50 workers	Overall means
Total	6.4%	14.3%	29.0%	9.1%
Sector				
Agriculture	5.8%	10.4%	33.3%	8.2%
Manufacturing and Textiles	6.2%	10.9%	28.0%	10.3%
Wholesale and retail	6.2%	11.0%	40.7%	8.0%
Community, social and other services	6.7%	17.3%	29.5%	9.2%
Construction	5.4%	9.1%	27.5%	7.2%
Finance	10.2%	25.7%	29.3%	14.9%
Hotels	5.6%	15.4%	25.6%	9.2%
Information technology	7.4%	23.9%	46.7%	13.6%
Transport	6.5%	17.1%	22.9%	8.4%
Sample size	13403			

Source: Authors' computation based on the Mauritius training and firm characteristics data set, 2007.
Note: These are firms that either trained only in 2007 or in 2007 and 2008. Firms that trained only in 2008 were excluded from this analysis.

Table 2: Regressions explaining training intensity and training probability

	Training Incidence			Training Intensity		
	Marginal effect	**Standard error**	**Elasticity**	**Maginal effect**	**Standard error**	**Elasticity**
Log average wage $\ln(W_i^T)$	0.055***	0.02	0.61	0.483**	0.20	0.48
Expected subsidy (S_{i0}^T)	0.258*	0.15	2.84	2.919*	1.52	1.53
Log expected training cost $\ln(C_{i0}^T)$	-0.001	0.005	-0.01	-0.024	0.05	-0.02
Log number of employees $\ln(N_i)$	0.022***	0.003	0.24	0.123***	0.03	0.12
Log Capital	0.008**	0.004	0.09	0.092***	0.04	0.09
Sector						
Agriculture	-0.003	0.02		-0.115	0.18	
Manufacturing and textiles	0.003	0.01		0.008	0.08	
Wholesale and retail	-0.004	0.01		-0.042	0.07	
Community, social and other services	0.001	0.01		-0.045	0.09	
Construction	-0.014	0.01		-0.131	0.10	
Finance	-0.025	0.02		-0.227	0.21	
Hotels	-0.010	0.01		-0.146	0.11	
Information technology	0.006	0.02		0.166	0.19	
Constant				-5.434***	1.51	
R^2	0.02			0.06		
Sample size	13403			13392		

Source: Authors' computation based on the Mauritius training and firm characteristics data set, 2007/2008
Notes: * significant at 10 percent **significant at 5 percent ***significant at 1 percent

Table 3: Total training levies paid and subsidies received in 2007, by firm size and sector cells, in million Mauritian rupees.

	Small 1-9 workers				Medium 10-50 workers				Large >50 workers			
	(1) Levy	(2) Subsidy	(2)/(1) Ratio	Ratio that Trained*	(1) Levy	(2) Subsidy	(2)/(1) ratio	Ratio that trained*	(1) Levy	(2) Subsidy	(2)/(1) ratio	Ratio that Trained*
Agriculture	0.94	4.71	5.01	0.07	2.31	1.51	0.65	0.12	14.3	1.99	0.14	0.40
Manufacturing and textiles	2.66	4.83	1.82	0.08	8.28	7.88	0.95	0.14	40.3	14.10	0.35	0.41
Wholesale and retail	3.24	10.30	3.18	0.09	4.06	2.97	0.73	0.14	11.4	3.10	0.27	0.51
Community, social and other services	3.4	9.02	2.65	0.08	5.62	3.72	0.66	0.21	11.9	3.60	0.30	0.35
Construction	1.86	2.59	1.39	0.07	4.07	2.49	0.61	0.12	11.6	2.39	0.21	0.37
Finance	3.3	6.93	2.10	0.13	6.07	6.17	1.02	0.32	22.2	70.10	3.16	0.43
Hotels	1.69	4.07	2.41	0.08	3.35	4.47	1.33	0.20	32.1	8.65	0.27	0.41
Information technology	0.98	1.67	1.71	0.12	1.92	10.70	5.57	0.31	3.39	0.62	0.18	0.60
Transport	6.86	24.60	3.59	0.08	10	16.00	1.60	0.20	24.3	5.88	0.24	0.34

Source: Authors' computation based on the Mauritius training and firm characteristics data set, 2007.
*Ratio that trained: number of firms that trained as a fraction of total number of firms in each sector.

Table 4: Regressions explaining various measures of firm output and growth using predicted intensity of training

Variables	**Log output**		**Log wage bill growth**		**Log employment growth**	
	Coeff	SE	Coeff	SE	Coeff	SE
Log capital	0.076***	0.007	0.020	0.015	0.039***	0.009
Predicted intensity of training	0.417*	0.241	0.061	0.105	0.027	0.064
Log number of employees	0.716***	0.060	0.042**	0.018	-0.076***	0.011
Sector						
Agriculture	-0.554***	0.164	-0.137***	0.052	-0.095***	0.032
Manufacturing and textiles	-0.656***	0.076	0.018	0.025	0.058***	0.015
Wholesale and retail	-0.287***	0.063	0.037*	0.022	0.006	0.014
Community, social and other services	-0.751***	0.081	0.022	0.025	-0.036**	0.015
Construction	-0.364***	0.100	0.106***	0.037	0.073***	0.023
Finance	-0.926***	0.140	0.096**	0.041	0.009	0.025
Hotels	-0.976***	0.076	0.029	0.037	-0.009	0.022
Information technology	-0.623***	0.139	0.162**	0.069	0.132***	0.043
Constant	13.308***	0.120	0.182	0.181	-0.503***	0.111
R^2	0.47		0.01		0.03	
Sample size	4013		10563		10562	

Source: Authors' computation based on the Mauritius training and firm characteristics data set, 2007.

Notes: * significant at 10 percent **significant at 5 percent ***significant at 1 percent

Appendix 1: Summary Statistics

Variable	Mean	
	2007	2008
Firm characteristics		
Percentage trained	11.93	6.64
Number of Employees	20.97	20.64
Grants received (conditional on training) (thousand rupees)	154.72	99.89
Grants received (unconditional) (thousand rupees)	18.46	6.63
Levies paid (thousand rupees)	18.06	18.23
Accounting Data (million rupees)		
Sales in 2007	45.90	33.00
Cost of Capital	19.30	18.80
Fraction of firms in		
Agriculture	0.08	0.07
Manufacturing and textiles	0.14	0.14
Wholesale and retail	0.13	0.29
Community, social and other services	0.14	0.14
Construction	0.08	0.08
Finance	0.05	0.06
Hotels	0.07	0.07
Information technology	0.02	0.02
Transport	0.28	0.11

Source: Authors' computation based on the Mauritius training and firm characteristics data set, 2007.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE ROLE OF FAIR TRADE IN DEVELOPING CORPORATE SOCIAL RESPONSIBILITY: AN EMPIRICAL EXAMINATION BASED ON MULTIPLE CASES

Khuram Shahzad, University of Vaasa, Finland

Dr. Ilkka Sillanpää, University of Vaasa, Finland

ABSTRACT

Purpose: *Corporate social responsibility is becoming more and more important for the firms from developed countries. The main purpose of this research paper is to examine empirically the role of fair trade in developing corporate social responsibility (CSR) and to find out the dynamics of CSR being used in organizations.*
Design/methodology/approach: *This qualitative case study research reviews the fair trade incorporating the historical developments, its conceptualization, and main motives along with CSR and its historical developments and conceptualization including major theories of CSR. The role of fair trade is developed by identifying the importance of CSR factors. To empirically examine the role of fair trade in developing CSR, this research employs the comparative multiple cases in Finland and Pakistan.*
Findings: *The main conclusions are as following: fair trade firms give equal importance to economic, social, and environmental responsibilities. Further, this study identifies the important factors included in each level of corporate social responsibility. Findings also reveal that suppliers are important stakeholders of the firms. Moreover, it depicts the importance of fair trade in developing CSR for diversified products.*
Originality/Value: *This research highlights the importance of fair trade in developing the economic, social, and environmental responsibilities of fair trade firms by focusing an important stakeholder group (i.e., suppliers). These trends represent the increasing demand of fair trade in businesses and also help them to know the important factors in corporate responsibility by considering the significance of suppliers as important stakeholders.*

KEYWORDS: Sustainability, corporate social responsibility, integration, fair trade.

INTRODUCTION

Corporate social responsibility (CSR) has been described as important responsibility which improves firm's competitive advantage, market value and financial performance (Maloney 2009). Corporate social responsibility reduces exposure to reputational risk, encourages the ability to enhance brand image, and improves corporate reputation via positive relationships. It increases the customer loyalty and helps to improve culture and recruitment, motivation, and retention of staff (Maloney 2009).CSR helps to identify its stakeholders (i.e., organizational stakeholders, economic stakeholders, and societal stakeholders) and to meet their needs (Carroll 1983; Werther & Chandler 2006). By articulating relationships with these stakeholders and fulfilling their needs, firms realize the importance of CSR and sustain its performance.

On general level, corporate social responsibility (CSR) is linked to ideas like; sustainability, corporate citizenship, the triple bottom line, socially responsible investment, and corporate governance (Maloney 2009). However, Frankental (2001) argues that "*CSR is a vague and intangible term which can mean anything to anybody, and therefore is effectively without meaning."*Further, he comments that "*CSR is highly subjective and therefore does not allow for a universally applicable definition*". In spite of all these difficulties in defining the CSR, Carroll (1983) steps forward and defines the CSR in following way;*"Corporate Social Responsibility involves the conduct of a business so that it is economically profitable, law abiding, ethical and socially supportive. To be socially responsible then means that profitability and obedience to the law are foremost conditions when discussing the firm's ethics and the extent to which it supports the society in which it exist with contribution of money, time and talent".*

The main concepts studied in this research are fair trade, CSR, and importance of fair trade in developing CSR. Most of the studies have focused either on fair trade or CSR separately. Only few studies have linked these both concepts together. Table 1 summaries the main important studies used to develop the research framework. These studies help this research to draw a picture to answer the main question of the research. Some of the studies are totally based on the fair trade phenomenon and explaining its dimensions whereas some studies are enlightening different dynamics of CSR and its theories. More importantly, the main studies who link up both of them (CSR and fair trade) are mentioned which direct to represent the role of fair trade in corporate social responsibility. In this vein, this research provides a theoretical background in different methodologies and its focus to the concept.

Author(s) / Years	Focus of studies	Methodology
Studies on fair-trade		
Davies (2007)	Investigation of the increased mass-marketing in the fair trade industry. The nature of participants in and industry structure in fair trade.	Longitudinal case study
Fridell (2009)	Analyses of fair trade network in the North through a comparative assessment of two different fair trade certified roasters.	Multiple case study
Hira and Ferrie (2006)	Fair trade activities increase awareness and availability of products. The challenges faced by fair trade for reaching the mainstream.	Theoretical
Jones et al. (2005)	Labeling initiatives is an opportunity to introduce fair trade products to the UK consumers via retail channels.	Case study
Moore (2004)	The defining characteristics of fair trade are covered and adoption of Southern producer perspectives to review the issues of fair trade. An investigation into pricing within the fair trade movement, related research projects, mainstreaming, and impact of fair trade on the Southern producers.	Theoretical
Nicholls (2002)	Expansion of market by examining the key drivers behind it, noting the growth of ethical consumerism as a contributing factor.	Survey
Studies on corporate social responsibility		
Bennett (2002)	Corporate social responsibility in MNCs and conflicts where multinational corporations have promoted international organization, the media, human right groups, social investors and consumers.	Multiple case study
Carroll (1979)	A conceptual model which describes the three essential factors of corporate social performance including answers of CSR social issues and modes of social responsibility.	Theoretical
Halme (2007)	CR brings something good for everyone, link between corporate responsibility and financial performance, social performance and implication of alternative CR action-orientation types with regard to financial and social performance.	Theoretical
Ketola (2006)	Eight different approaches to corporate responsibility and variations in the CR emphases between different companies.	Multiple case study

Ketola (2008)	Corporate responsibility can be utilized to manage and develop individual, cultural and biodiversity and turn them into business strategy.	Multiple case study
Meehan et al. (2006)	Develops a link between CSR definitions and strategy and offers guidance to managers on how to connect socially to achieve economic and social objectives.	Theoretical
Studies on fair trade in CSR		
Audebrand and Pauchant (2009)	Historical study of fair trade movement focuses on the originalities and challenges of the FT movement and its contributions to the current theory and practice in business ethics.	Theoretical
Bezencon and Blili (2009)	The motivations of distributors of fair trade products and how they organize and communicate fair trade values. Strategies and managerial practices related to fair trade product distribution.	case study
Davies and Crane (2003)	The study of ethical decision making in fair trade company.	Survey
Reed (2008)	Corporate participation has the potential to rapidly extend the market for fair trade goods, primary concern for the plight of small producers and goal of developing an alternative approach to trade and development.	Theoretical
Strong (1997)	The role of fair trade principles within sustainable development. The relationship between customers and environment and idea of sustainable development incorporated human aspect of sustainability.	Theoretical

Table 1. Some previous studies.

The purpose of this research is to help the managers to understand the importance of fair trade in developing CSR in their business activities by highlighting the importance of societal environmental responsibilities along with financial benefits. To empirically investigate the role of fair trade in developing CSR, this research chooses multiple cases as research strategy in food sector.

The main research question of the study is:

How does fair trade perform the main role in organizing or developing corporate social responsibility (CSR)?

Fair trade permits a realistic set of improved trading conditions that allow substantial volume to be traded against these improved conditions and it actually leads to an increase in producer income. It develops code of conduct and standards that really come to the reality of compliance, sustainable production and a better product with a better price (Perk 2006). Fair trade creates new ways in CSR to define better trading conditions that do not interfere with the market and create a social framework which allow prices to tell the truth about social and environmental production costs (Perk 2006).

Fair trade is an old business activity which adds ethics into business and seeks greater equity in international trade (Fairtrade Labelling Organization International 2009).Fair trade offers the better trading conditions in sustainable development for the fair trade producers and workers especially in the South. Fair trade organizations participate actively in supporting producers, raising the awareness and practice of conventional international trade. It helps the producers and workers to move from a position of susceptibility to security and economic self-sufficiency. Fair traders have done much to increase consumer and business awareness of the issues involved while helping small producers improves the conditions under which they work and live. Fair trade certified products help to increase availability and variety, to raising public awareness and to develop and manage the CSR in the organizations. Fair trade improves the social consciousness of the consumers and increase pressure toward the broader adoption of ethical codes of conduct by mainstream processers and retailers.

RESEARCH PARADIGMS

Methodological approach can be either qualitative or quantitative. This research consists of a qualitative research method with an inductive approach. Furthermore, qualitative research typically combines data collections methods such as archives, interviews, questionnaire, and observations. The evidence may be qualitative, quantitative, or both (Eisenhardt 1989). These different ways of data collection give flexibility to researcher in data collection than quantitative method. This means that researcher has an opportunity to get deep inside into the research phenomenon and come close to the respondents for the affective analyses. In conclusion, qualitative method is suitable to analyze the exploratory study by emphasizing on understanding and observing the concept (Ghauri, Kjell& Ivar 1995).

For this research paper, method base is qualitative research as research strategy. The qualitative research approach fits to the nature of research question (i.e., how) of this study, which starts as "*How does fair trade perform the main role in organizing or developing corporate social responsibility (CSR)?"*The choice of qualitative research will help to go

more in depth of research phenomenon. This research uses multiple case studies as research methodology. According to Yin (2003), "case study is an empirical enquiry that investigates a contemporary phenomenon within its real life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used". According to Eisenhardt and Graebner (2007), multiple case studies are beneficial in many ways as; 1) it provides replication logic, 2) it helps in extending the existing theory, 2) it helps to focus on real world context, and 4) it helps in developing theory. According to Eisenhardt (1989), the sampling of cases from chosen population is unusual when building theory from case studies. Such research relies on theoretical sampling (i.e., cases are chosen for theoretical, not statistical reasons).

The basic purpose of primary data was to get information that is related to personal understandings, experiences, and observations. As a result, primary data was collected through digitally recorded unstructured interviews with open-ended questions. Further, to gain the basic information about the case companies' histories, operations, industry context, annual profit, and current activities, secondary data was collected from case companies' websites, annual reports, and old magazines for a detail version of the information along with primary data.

Data analysis is an important part for developing results. Yin (2009) describes the data analysis as; examining, categorizing, recombining, and tabulating the evidences. He arranges the data analysis in two strategies;1) focuses on the relation of data with theoretical framework derived from literature, and 2) focuses on the development of case description and descriptive framework to present the data. Validity and reliability measures are used to test the quality of the study. These measures can be considered as an ideal of the research. Validity and reliability provide researcher a source to test the quality of the research and the credibility of the results. Whereas validity concerns not only with the data collection but focuses on the coherence of the research and relation of findings. It refers the accurate measures taken in research and truthfulness of the results (Saunders et al. 2007). Yin (2009) posits that validity can be divided into; construct, internal, and external validity. In conclusion, present research is not looking for causal relationships between the variables, so internal validity is not concerned in present study.

Reliability refers to minimize random error, enabling subsequent researchers to arrive at the same insights if they conduct the study along the same steps again (Gibbert et al. 2008). The key words here are transparency and replication. Transparency can be enhanced through measures like careful documentation and clarification of the research procedures Replication may be accomplished by putting together a case study database, which should include the case study notes, the case study documents, and the narratives collected during the research, organized in such a way as to facilitate retrieval for later investigators (Gibbert et al. 2008). In present research, questions were designed according to the theoretical framework so that respondents should have a focus on the main point to ensure the reliability. The idea was to develop a relationship between the questions and their explanation about the topic to explore relative results. The language used in interviews was English to minimize the risk of misinterpretation and misunderstanding the answers for the credible and reliable results. However, the results of the research are based on the subjective evaluation and subjective interpretation for respondents and the author. Thus, chosen respondents were the people who had a great knowledge about the fair trade and corporate social responsibility.

THEORY OF FAIR TRADE AND CSR

Fair Trade

Most of the world's biggest companies have started fair trade brands and they are trying to incorporate it into their CSR agendas. This has resulted in considerable sales growth for the network stakeholders (Fridell 2009). Fair trade (i.e., alternative trade) was developed as an alternative model of business with political activity, i.e. "a business and campaign" (Zadek & Tiffen 1996). The basic purpose of the international fair trade activities is selling products from marginalized Southern producers (Low &Davenport 2005). In the early 1990s, fair trade considerably developed and grown into the broad product groups, differentiating and directing the products in the biggest market. Fair Trade Labeling Organization (FLO), Fair Trade Foundation (FTF) and International Federation for Alternative Trade (IFIAT) are the authorities of fair trade that are engaged in oversee fair trade activities and to audit related organizations. A group of profit seeking companies was developed in 1990s; the purpose was to create a profit from ethical group of consumers, therefore, this era named as niche market era of fair trade. After that, many companies engaged in the fair trade business and expanded it into leading products lines that created the mass-market era of fair trade (Davies 2007). This era also resulted in development of fair trade conceptualization.

Raynolds et al. (2007) highlights the importance of groups involved in fair trade and defines the fair trade as "Fair Trade movement is comprised of a set of groups which are linked through their membership associations – the Fair Trade Labelling Organizations International (FLO), the International Federation of Alternative Trade (IFAT), the Network of European World shops (NEWS!), and the European Fair Trade Association (EFTA)." These organizations work together as a FINE network. FLO is a united organization which labels fair products to ensure the intensity of fairness in the products marked in large volume distribution. Moreover, there are tensions between two visions of radical and pragmatic. Radical conception observes fair trade as a tool, and the pragmatic concept highlights the inclusion of products from the South to North markets.
Figure 1 summarizes all about industry structure of Fair Trade organizations, containing four main groups of organizations; the producer organizations, buying organizations, umbrella organizations, and supermarkets. Umbrella bodies that consist of a combination of six further organizations, i.e., IFAT, FLO, NEWS, EFTA, FTF, and Shared Interest (Moore 2004). IFAT, FLO, NEWS, EFTA, FTF are the organizations that have discussed earlier, but there is an organization in umbrella bodies called shared interest. It is not a trade organization like other bodies, but it helps in trading activities by providing trade finance to the fair trade movement through a channel of clearing house, which has been serving producers certified by FLO.

Industry structure

Main organizations involved in the Fair Trade movement can be divided into four groups that further have detailed structure.

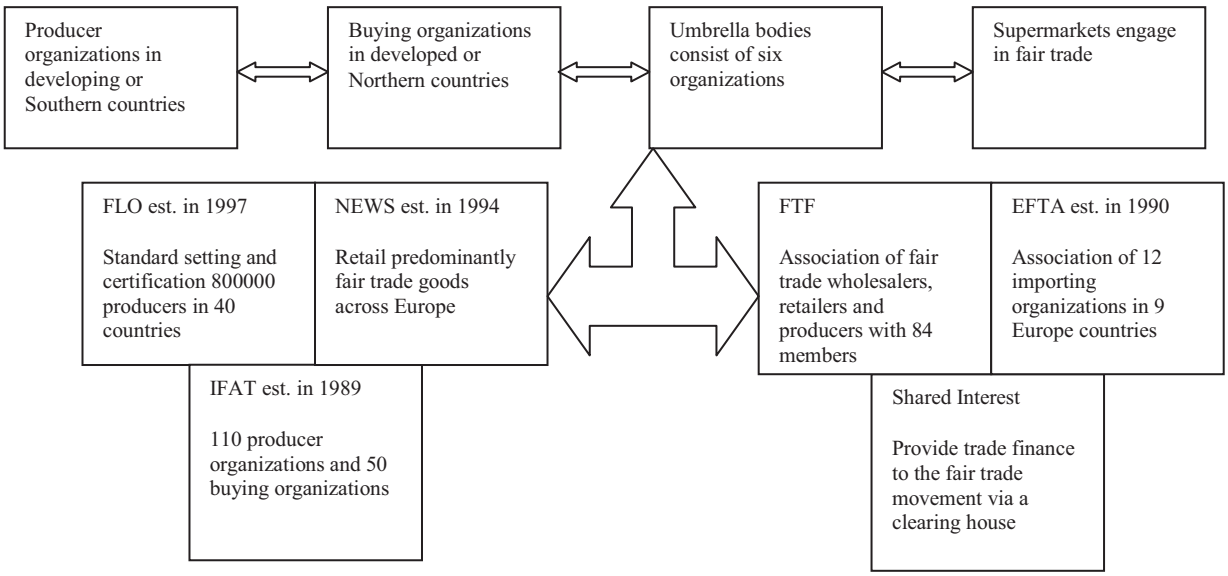


Figure 1. Industry structure of fair trade.

Fair trade movement is a link between social responsibility and free-market capitalism, which ensures the living wage, affordable credit facilities, and promote different activities that are sustainable for workers and environment (Linton, Chiayuan & Ann 2004). Low and Davenport (2005) identifies five different types of businesses, consisting of fair trade organizations, value driven business, proactive CSR business, defensive CSR business, and disbelievers.

In this research, some fair trade challenges exist that are complicated and overlapped. First challenge is all about the increasing activities of fair trade in the global market by capturing business partners, huge markets and customers, large-scale traders, distributors, supermarkets, and many other related retailers. Second challenge for fair trade arises from the incorporation of large-scale estates or plantations within fair trade production, requiring the needs production of extraordinary certified goods, integration of bigger numbers of producers, and workers. The third challenge of fair trade is about the changing nature of the movement. Traditionally, fair trade was depending on the Northern NGOs and Southern producers and workers, but now the trend of fair trade is changing and getting advance in its activities after the success of their hard work. The final challenge is all about the shifting consumer base (Raynolds et al. 2007), and its importance in the development (Hira & Ferrie 2006).

Corporate social responsibility

For the past many years, academia has been trying to explain and define the Corporate Social Responsibility (CSR) concept to develop a proper definition, but still lacks consensus on the conceptualization of CSR concept (Dahlsrud 2006). Moon (2004) argues that CSR is a complicated idea which cannot be clearly defined. It is difficult to distinguish CSR from related concepts of sustainable business, corporate citizenship, environmental responsibility, the triple bottom line; social, environmental, and corporate accountability. Further, research

presents multiple views on CSR, such as social performance, business ethics, social contracts, stakeholder management or triple bottom line (cf. Carroll 1979; Moon 2004; Valor 2005). CSR is a concept of core performances and responsibilities of the companies which has a strong impact on the societies in which they concern. It is not an optional set of activities for the organizations (Dahlsrud 2006).

Ideologies of corporate responsibilities

Spielman (2000) explains CSR ideology, and differentiates the responsible business behavior from irresponsible business behavior. He argues that in responsible business behavior, organizations focus more on economic welfare of employees to keep them retain and to provide benefits to the consumers with fair products. It is a group effort in an organization for the wellbeing of general public and especially for the environment. While, irresponsible business behavior is an act of serious actions such as (unethical economic harm) impose to the employees, unfair products and services to the consumers, unfair competitions with other organizations and harmful for the general public and environment (Spielman 2000).

Desjardins (1998) presents three kinds of CSR ideologies that are important for the organizations. These ideologies are;

- Owner focused ideology
- Stakeholder Ideology
- Broad responsibility Ideology

Owner focused ideology is called classical ideology. In this ideology, organizations focus on the revenue of shareholders by maintaining the high profit ratio and financial growth of the company (Desjardins 1998). Whereas stakeholder ideology is called neoclassical ideology. It signifies a general concept that organizations are responsible for their stakeholders in addition to their responsibilities for shareholders. This ideology is an integration process of economic, socio-cultural, and ecological responsibilities in which each level is a set of activities toward society, humanity and environment (Desjardins 1998).

CSR theories

Garriga and Mele (2004) developed CSR theories by using a structural approach to organize CSR into four proportions or groups that define the relationship between business and society. These groups are 1) Instrumental theory, 2) Political theory, 3) Integrative theory, and 4) Ethical theory.

Instrumental theory is a strategic tool to get economic goals and wealth creation. It is all about the profit increasing actions. Friedman presents it as “social responsibility of business is to increase its profit” (Friedman 1970). Further, Windsor (2001) argues that “a leitmotiv of wealth creation progressively dominates the managerial conception of responsibility” (Windsor 2001). There are three following sub-groups of instrumental theory; maximization of value of shareholders, achieving competitive advantage, and cause-related marketing actions (Garriga & Mele 2004). Whereas political theories represent the linkage between business and society based on the power and position in business. Political theories comprise of two major theories called “corporate constitutionalism”, and “corporate citizenship” (Garriga & Mele 2004). This group of theories focuses on the discovery, scanning of, and

response to the social stress to get social legitimacy, prestige and social acceptance. Integrative theories define the integration of social demands and business dependence on society (Garriga & Mele 2004). There are four groups in integrative theories that clear the concept of integration in CSR. These include; 1) issue management, 2) the principle of public responsibility, 3) stakeholder management, and 4) corporate social performance (Garriga & Mele 2004). Further, ethical theories posit that organizations should focus on the betterment of society by providing those best and harmless products and services, and they should contribute positive activities for the wellbeing of the society (Garriga & Mele 2004). In the positive activities, there are several ways to contribute, and these may be in different forms.

Corporate social responsibility and stakeholder theory have a strong relationship with each other. To survive and fulfill its economic and non economic objectives, firms have learnt to invest in CSR activities to meet the needs of various stakeholders (Argandona 1998; Harvey & Schaefer 2001; Post 2003). Stakeholders are those groups which have a stake in company's operations. They can be divided into three different forms of; 1) organizational stakeholders (i.e., employees, managers, and unions), 2) economic stakeholders (i.e., customers, creditors, distributors, and suppliers), and 3) societal stakeholders (i.e., communities, governments and regulators, and non-profit and non-governmental organizations) (Werther & Chandler 2006). In the same vein, Clarkson (1995) divided above stakeholders groups into two forms; primary and secondary stakeholders. The primary stakeholders consist of customers, distributors, shareholders, employees, and suppliers. Further, the secondary stakeholders consist of governments, competitors, and civil societies.

In stakeholder theory, the managers play an important role in supporting all stakeholders' groups with balancing and maximizing the interests of stakeholders overtime (Freeman & Phillips 2002). Regarding the responsibilities, this theory has articulated the shared sense of the value that managers create and bring them together. Stakeholder theory allows firms to produce outstanding performance by focusing on different relations with stakeholders (Freeman 1994). In the following figure 2, the important stakeholder's groups are identified:

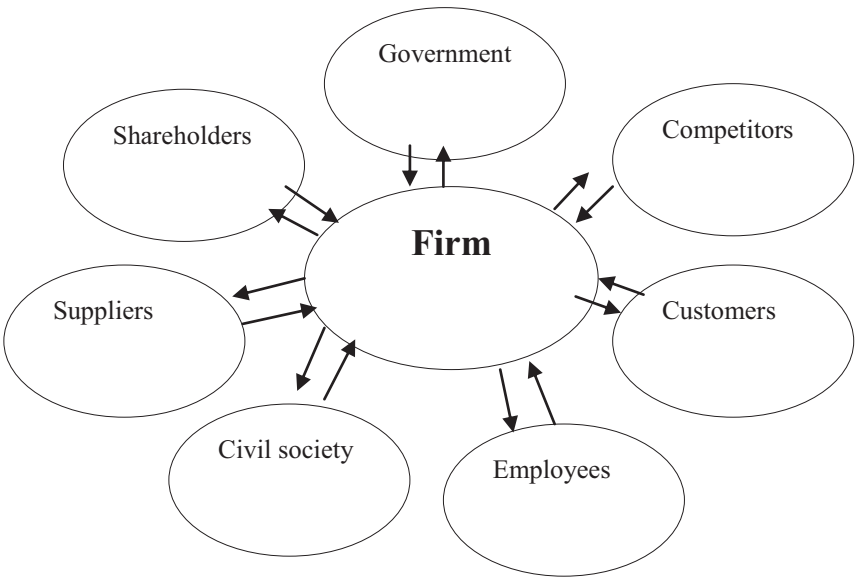


Figure 2. Stakeholder theory of the firm (Crane & Matten 2007: 59).

Stakeholder theory is one of the most used and prominent theories in international business activities and CSR discourses. Philips (2003) suggests that there should be a distinction between normative and derivative stakeholders in order to identify them. Normative stakeholders are those who have ethical responsibility towards the other social factors. The link between CSR and stakeholder theory demonstrates the relationship between social disclosures, and social and economic performance (Ullmann 1985).

Key elements of fair trade in corporate social responsibility

Stakeholders are an important part of the organization and all the firm's operations revolve around their significance. Economic responsibility focuses on the financial sustainability of the firms and it is integrated in firm's norms (Ketola 2009a). Socio-cultural responsibilities consist of those activities and practices that embody fairness, justice, standards and ethical responsibilities (Carroll 1991). Social responsibility symbolizes the standards, norms or expectations that replicate consumers, employees, shareholders and community's regard and respect or protection. Social responsibility is achieved by respecting the limits of human and culture. Developing countries are characterized by environmental degradations, which also affect the social conditions. In response to these limitations in developing countries, fair trade performs a key role to sustain and achieve the required objectives (Strong 1997). Whereas, fairly traded products encourage the model of consumption and production in those societies, which helps to reduce environmental stress, and to meet the needs of humanity. Fair trade products ensure the suppliers of developing countries for a standard production process, benefits of trade, and good working conditions for employees (Strong 1997).

Summary of theoretical framework of the research

Fair trade as a component of economy movement or objectives of corporate social responsibility and ethical trade can be viewed by several ways. This research focuses on the role of fair trade in corporate social responsibility means that fair trade is a part of ethical consumerism and many factors of CSR. Fair trade movement creates the environment for responsible business to become more responsible, community oriented and environment oriented. For the reason, customer demands for fair traded products also open the ways of awareness of fair traded products and to help marginalized producers in less developed countries. Moreover, fair trade movement encourages the community development and assigns power to the producers. To protect human rights, fair trade mechanism has become a complete package (Davies & Crane 2003).

In this sense, Figure 3 summarizes the role of fair trade principles in corporate social responsibility (CSR). The Figure shows the clear impact and role of fair trade in corporate social responsibility levels. This role of fair trade in CSR levels means that it also has a significant impact on internal and external stakeholders of the firm because all stakeholders are related to CSR values and areas: economic, social and environmental. These factors are kept into mind while collecting the empirical material while the focus is clearly on fair trade role in corporate social responsibility. Fair trade and corporate social responsibility concepts are closely related to some other concepts like ethical consumerism or ethical business but to get reasonable results, or to build a clear concept of role of fair trade, empirical data is collected only on the base of fair trade role in corporate social responsibility which is the key question of the research.

Furthermore, this research provides the impact of fair trade role in CSR's levels separately which means it discusses the stakeholder theory separately in CSR levels and relationships of all stakeholders to each other as well. Figure 3 elaborates the concepts of economic, social and environmental responsibility and consists of several important contents of three of responsibilities. Economic responsibility presents four main factors which are related to internal and external stakeholders. *Managerial factors* related to internal stakeholders that provide different management issues in CSR and the effects of fair trade in these issues. *Technical factors* are related to quality, machinery and production issues and they belong to internal stakeholders as well. *Financial dimensions* provide the clear picture of financial profitability and competitiveness and the last factor of economic responsibility is *economic factors* which is related to external stakeholders including costumers, society, economy etc. (Mikkilä 2005).

There are four factors of social responsibility discussed in this study related to internal and external stakeholders. These important factors of social responsibility show the effects of fair trade role in the society. Employment and cultural factors are related to internal stakeholders while societal and political dimensions are linked with external stakeholders. In these dimensions of social responsibility, fair trade performance in different areas is discussed empirically. Fair trade has a significant impact on the three levels of environmental responsibility. These dimensions of environmental responsibility consist of *industrial environment factors*, *natural resources factors* and *production and consumption factors* (Mikkilä 2005).

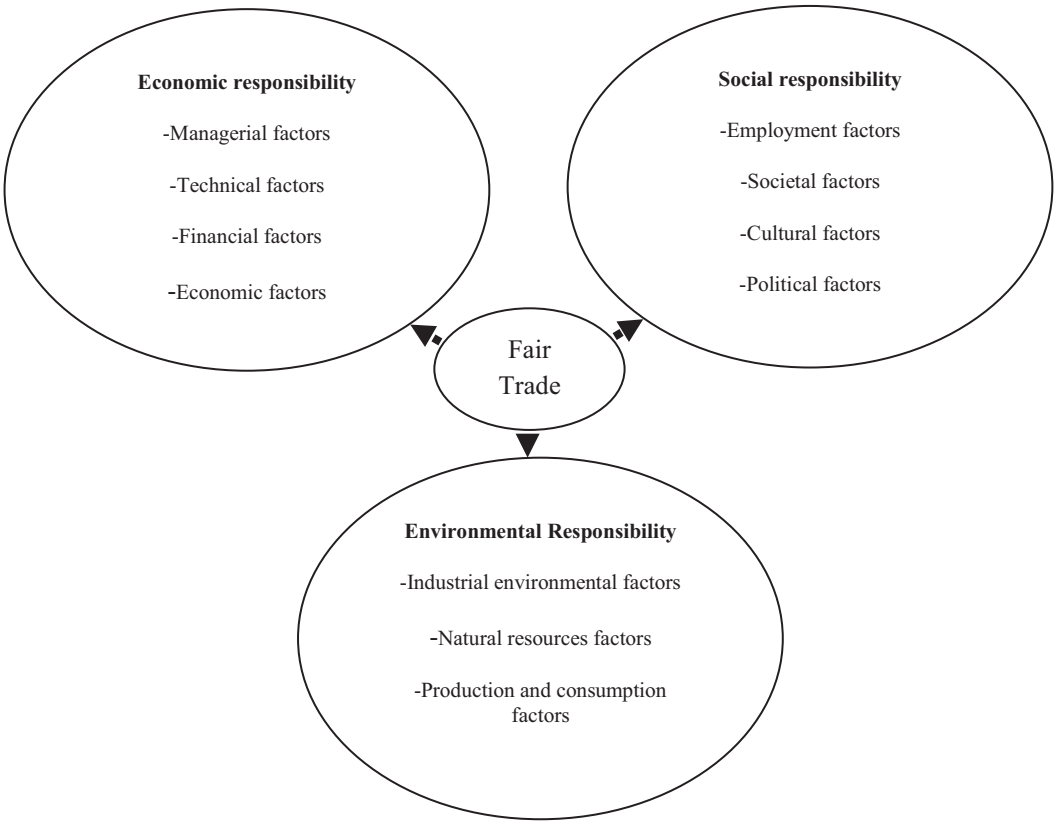


Figure 3. Theoretical framework.

EMPIRICAL STUDY

This research focused on the role of fair trade in developing CSR in case companies from Pakistan and Finland. CEO of Pakistani Company is interviewed and some officials from Finland Company are interviewed. Identical questions were asked to all of the officials and they have been allowed to answer after taking as much time as they want. Interview questions were developed according to the theoretical framework of the research so that results would create a combination between theory and empirical findings. By keeping in mind all above validity factors, data was collected and the results of this research demonstrate a key relation of fair trade role in corporate social responsibility in the case companies.

Mountain Fruits (Pvt.) Limited Pakistan was developed by the Aga Khan Rural Support Program in 2000. The purpose was to train the people to improve the drying fruit practices by utilizing the hygienic fruit drying system in the northern areas of Pakistan, and to create the opportunities for disadvantaged producers for organizing, producing, and selling the international quality products under fair trade mark. The company targets the producers of dried apricots, wild apricots; apricot kernels (sweet and bitter), dried apples, organic walnuts and almonds from the northern areas of Pakistan (Mountain Fruits). Furthermore, it helps the "mountain areas fruit farmers' association" (i.e., a group of 2,000 farming families from 78 different village organizations located in the mountainous northern areas of Pakistan) to promote their products in developed countries (e.g., United Kingdom) through fair trade. It trains the farmers in improved agriculture techniques, making the farmers to be flexible with the technology.

Reilu Kauppa is a non-profit organization, having 30 member organizations. The main goal is to raise awareness and promote fair trade in general. It licenses the use of fair trade certification mark in Finland and Baltic States. The company is also involved in monitoring and approving the usage of fair trade mark. There are 1500 fair trade certified products in Finland, and consumption of fair traded products in 2009 reached to € 86.9 million which makes € 16.31 per capita. The case organization is trying to tenfold its sales in coming 5 years (i.e., 2010-2015). According to the company's annual report (2009), 82% consumers in Finland know about fair trade, and 49% want to buy more fair trade products. Further, 78% consumers in Finland have a confidence on fair trade mark. In conclusion; the company provides an opportunity to producers in developing countries to promote their wellbeing through fair trade, and an opportunity to consumers in Finland to consume the fair trade products in line with their own values.

This section analyzes the theoretical model of this research in the light of findings from the above case companies. The discussion examines the role of fair trade in developing the corporate social responsibility (i.e., economic, social, and environmental factors). Economic responsibility focuses on the financial sustainability of the firms. Carroll (1991), and (Ketola 2009a) argue that business organizations are made for the economic activities, and profit motives are primary incentive for all the organizations. In the case company A (Mountain Fruits (Pvt.) Limited Pakistan), the intentions were to give economic benefits to farmers (i.e., suppliers). The main factors included in economic benefits were reducing production costs, assigning good prices to products, increasing competitiveness of producers' products, increasing their profitability, and helping them to reinvest some profit in expanding business. In the same vein, the case company B (Reilu Kauppa) is a non-profit organization. The case

company promotes fair trade between Finland and developing countries, with the intentions to give economic benefits to producers. The main factors included in economic benefits were; assigning good prices to producers' products, and increasing their profitability.

Case companies	Role of fair trade in developing the economic responsibility
Case company A	To reducing the producers' production costs, assigning good prices to their products, increasing competitiveness of their products, increasing their profitability, and helping them to reinvest some profit in expanding business
Case company B	Assigning good prices to producers' products, and increasing their profitability

Table 2. Role of fair trade in developing economic responsibility.

Socio-cultural responsibilities focus of those activities and practices that embody fairness, justice, standards and ethical responsibilities (Carroll 1991). Fair-trade labeling organizations and importers in developed countries ensure about the satisfaction of developing countries' producers in terms of their social needs. In the case company A the assurance of farmers' satisfaction with their social needs was the most important responsibility. The main factors included in social benefits were; following the national and international laws about the labor rights, providing fair salaries, employees training, employee's health and safety, managing employee's cultural diversity, education of village children, forbidding child labor, and creating opportunities for all without discrimination. In the same vein, the case company B also contributes to social welfare of producers in developing countries. The case company takes into consideration the needs and special characteristics of different-sized producer organizations and makes sure that they are fulfilled. The main factors included in social responsibilities are; fair Payton workers, no child labor, education of farmer's children, decent living standards of workers, schools, health clinics, safe water and simple bridges.

Case companies	Role of fair trade in developing the social responsibility
Case company A	Following the national and international laws about the labor rights, providing fair salaries, employees training, employee's health and safety, managing employee's cultural diversity, education of village children, forbidding child labor, and creating opportunities for all without discrimination.
Case company B	Fair pay to workers, no child labor, education of farmer's children, decent living standards of workers, schools, health clinics, safe water and simple bridges.

Table 3. Role of fair trade in developing social responsibility.

Organizations achieve environmental responsibility by staying within the limits of carrying capacity of ecosystems (Ketola 2009a). Ketola (2009a) argues that practices like usage of renewable energy forms, zero emissions, and recycled or renewable natural resources constitute as environmental responsibilities. The case company A makes sure that the

producer is making environmental friendly product. The main factors included in environmental responsibilities were; shipment by sea, wastage handling, pollution reduction. In the same vein, the case company B also helps the producers in preserving the environment. According to case company's 10th anniversary report (1999-2009), fair-trade environmental standards call for the protection of the natural environment and encourage to work towards organic practices. The environmental standards include; environmental impact assessment, planning and monitoring, soil and water protection, reductions in the use of agrochemicals and compliance with the FLO Prohibited Materials List, guidelines on correct waste management, and ban on genetically modified organisms (GMOs).

Case companies	**Role of fair trade in developing the environmental responsibility**
Case company A	Shipment by sea, wastage handling, pollution reduction
Case company B	Soil and water protection, reductions in the use of agrochemicals, correct waste management, and ban on genetically modified organisms

Table 4. Role of fair trade in developing environmental responsibility.

CONCLUSION

Most of scholars agree that fair trade is becoming more and more important for the firms from developed countries (e.g., Davies 2007; Fridell 2009; Hira and Ferrie 2006). In the light of this increasing interest in fair trade, previous research has focused on conceptualization of fair trade and its general benefits to producers in developing countries (e.g., Moore 2004; Fridell 2009; Low & Davenport 2005). Despite these recent interests, current research is silent in describing the comprehensive responsibilities of fair trade firms. This research therefore seeks to examine the role of fair trade in developing corporate social responsibility. The key findings of this research are: First, fair trade firms give equal importance to economic, social, and environmental responsibilities. This finding depicts that fair trade is an organized movement to help the marginalized producers in all areas of corporate social responsibility, comprising of economic, social, and environmental areas. Previously, research has either focused on the importance of fair trade for generating only economic benefits to producers (Smith 2007), and economic and social benefits to producers (Ronchi 2002; Lyon 2007; Mare 2008),or have considered fair trade as a form of CSR (Mohan 2009). However, this research finds that fair trade companies give equal importance to economic, social, and environmental responsibilities to develop the livelihood of the producers.

Second, this research identifies the important factors included in each level of corporate social responsibility (i.e., economic, social, and environmental). Figure 9 presents the main factors included in economic responsibility, social responsibility, and environmental responsibility of the fair trade firms. These findings support and extend the previous research on corporate social responsibility (e.g., Bennett 2002; Meehan et al. 2006; Carroll 1979).

Third, this research depicts that producers are important stakeholders of the company. Fair trade firms develop corporate social responsibilities by highlighting the significance of producers. By fulfilling corporate social responsibilities (i.e., economic, social, and environmental), the fair trade firms create goodwill of producers among consumers. Fourth,

previous research on fair trade has mostly focused on coffee (e.g., Ronchi 2002; Lyon 2007; Renard 2003; Low & Davenport 2005), giving limited evidence about the importance of fair trade for diversified products. However, this research depicts the importance of fair trade in developing corporate social responsibility for diversified products (i.e., Apricots, Apple, Wine, Coffee, and etc.).

Figure 4 shows the adopted model on the role of fair trade in developing corporate social responsibility. Model combines the theory and main empirical findings and depicts a rich picture that fair trade firms give equal importance to economic, social, and environmental responsibilities. Further, model depicts the important factors included in each responsibility (i.e., economic, social, and environmental) of fair trade firms.

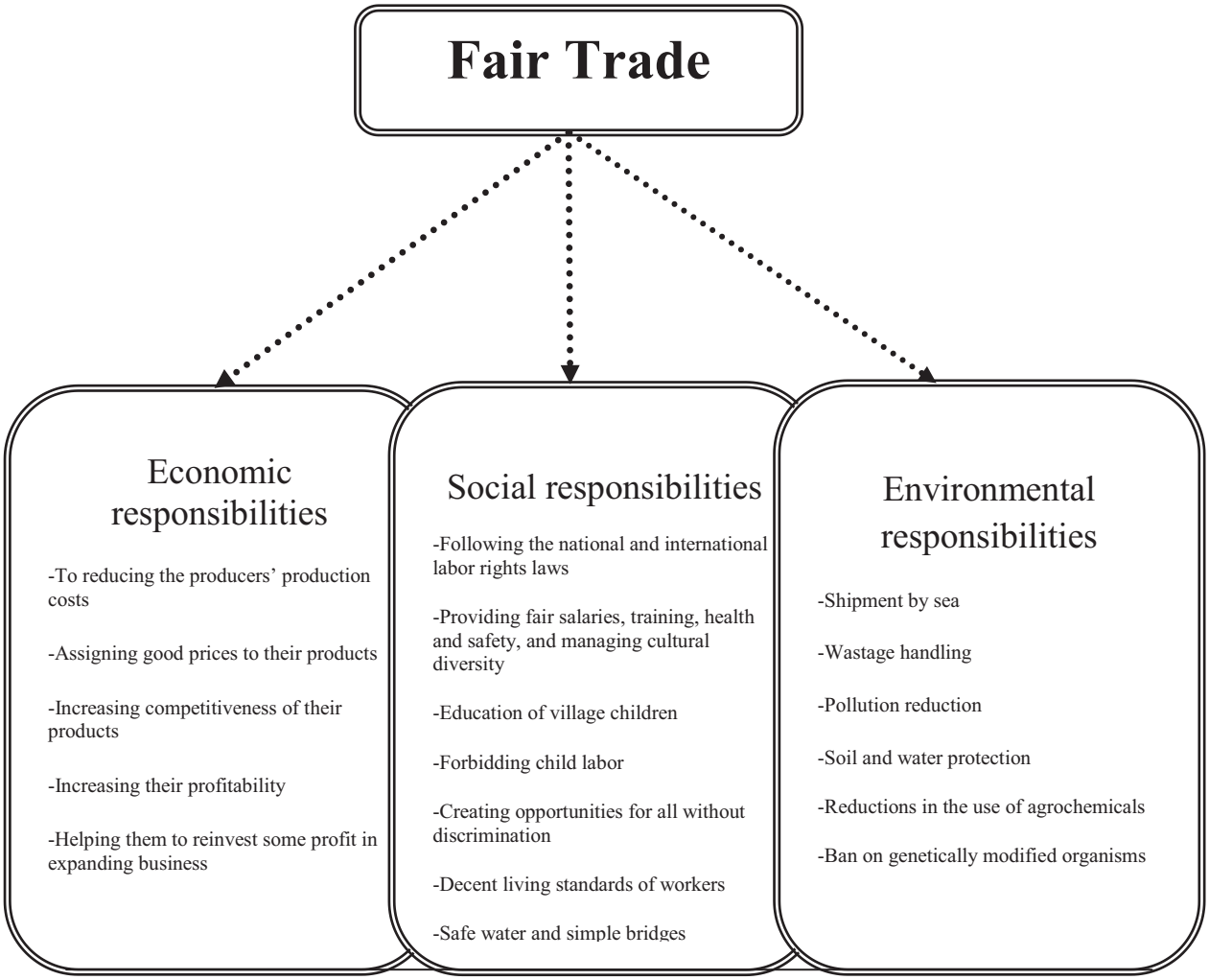


Figure 4. Developed framework of fair trade role in (CSR).

Managerial implications and future research suggestions

This research study has given results on the role of fair trade in developing corporate social responsibility. A major contribution of this research is that it highlights the importance of fair trade in developing the economic, social, and environmental responsibilities of fair trade firms by focusing an important stakeholder group like suppliers. Further, the research brings

out the important factors included in each responsibility (i.e., economic, social, and environmental) of fair trade firms.

These empirical findings have several empirical implications. Firstly, the demand of fair trade products is increasing in developed countries on general level, and specifically in Finland. According to the annual report of Reilu Kauppa (2009), 82% Finnish consumers know about fair trade, 49% want to buy more fair trade products, and 78% Finnish consumers have a confidence on fair trade mark. These trends depict that demand of fair trade is increasing in Finland. So, the Finnish firms should know the importance of fair trade and its role in corporate social responsibility. Secondly, research findings can help the Finnish firms to know the important factors involved in each responsibility (i.e., economic, social, and environmental) of fair trade firms. Thirdly, the research findings can help the Finnish firms to know about the significance producers of developing countries as an important stakeholder.

Regarding future research directions; firstly, research should incorporate the viewpoint of all stakeholders (i.e., producers, consumers, importers, distributers, and etc.) on the role of fair trade in developing corporate social responsibility. Secondly, most of previous research on fair trade has concentrated on a single product of coffee than diversified products. Future research should focus on the importance of fair trade in diversified products. Thirdly, most research on fair trade and corporate social responsibility is either conceptual or based on case studies. The future research should conduct quantitative research with bigger sample sizes to have more external validity.

REFERENCES

1. Argandona, A. (1998), “The stakeholder theory and the common good”, Journal of Business Ethics, Vol. 17 No. 9/10, pp. 1093-1102.
2. Audebrand, L.K., and Pauchant T.C. (2009), “Can the fair trade movement enrich traditional business ethics? An historical study of its founders in Mexico”,
3. Journal of Business Ethics, Vol. 87, pp. 343-353.
4. Bennett, J. (2002), “Multinational corporations, social responsibility and conflict”, Journal of International Affairs, Vol. 55 No. 2, pp. 393-410.
5. Bezencon, V., and Blili S. (2009). “Fair trade managerial practices: Strategy, organization and Engagement”, Journal of Business Ethics, Vol. 90, pp. 95-113.
6. Carroll, A.B. (1979), “A three-dimensional conceptual model of corporate social performance”, Academy of Management Review, Vol. 4, pp. 497-505.
7. Carroll, A.B. (1983), “Corporate social responsibility: will industry respond to cutbacks in social program funding”? Vital Speeches of the Day, Vol. 49, pp. 604-608.
8. Carroll, A.B. (1991), “The pyramid of corporate social responsibility: toward the moral management of organizational stakeholders”, Business Horizons, Vol. 34 No. 4, pp. 39-48.
9. Clarkson, M.E. (1995), “A stakeholder framework for analyzing and evaluating corporate social performance”, Academy of Management Review, Vol. 20 No. 1, pp. 92-118.
10. Crane, A., and Matten D. (2007), Business Ethics. Second Edition, Oxford University Press, New York, NY.

11. Dahlsrud, A. (2006), "How corporate social responsibility is defined: an analysis of 37 definitions", Corporate Social Responsibility and Environmental Management, Published Online in Wiley InterScience, (www.interscience.wiley.com).
12. Davies, Lain A. (2007), "The eras and participants of fair trade: an industry structure/stakeholder perspective on the growth of the fair trade industry", Corporate Governance, Vol. 7 No. 4, pp. 455-470.
13. Davies, Lain A., and Crane A. (2003), "Ethical decision making in fair trade companies", Journal of Business Ethics, Vol. 45, pp. 79-92.
14. Desjardins, J. (1998), "Corporate environmental responsibility", Journal of Business Ethics, Vol. 17, pp. 825-838.
15. Eisenhardt, Kathleen M. (1989), "Building theories from case study research", Academy of Management Review, Vol. 14 No. 4, pp. 532-550.
16. Eisenhardt, Kathleen M., and Graebner Melissa E. (2007), "Theory building from cases: opportunities and challenges", Academy of Management Journal, Vol. 50 No.1, pp. 25-32.
17. Fairtrade Foundation, Mountain Fruits (Pvt.) Limited. [Online], available at: http://www.fairtrade.org.uk/producers/dried_fruit/mountain_fruits_pakistan/default.aspx (accessed 21 October 2010).
18. FLO (2009), Fair Trade Labeling Organizations International. [Online], available at: http://www.fairtrade.net (accessed 21 March 2010).
19. Frankental, P. (2001), "Corporate social responsibility–a PR invention"? Corporate Communications an International Journal, Vol. 6 No. 1, pp. 18-23.
20. Freeman, R.E. (1994), "The politics of stakeholder theory", Business Ethics Quarterly, Vol. 4 No. 4, pp. 409-421.
21. Freeman, R.E., and R. Phillips (2002), "Stakeholder theory: a libertarian defense", Business Ethics Quarterly, Vol. 12 No. 3, pp. 331-350.
22. Fridell, G. (2009), "The Co-operative and the corporation: competing visions of the future of fair trade", Journal of Business Ethics, Vol. 86, pp. 81-95.
23. Friedman, M. (1970), "The social responsibility of business is to increase its profits", published in New York Times Magazine, September 13th, 1970.
24. Garriga, E., and Mele D. (2004), "Corporate social responsibility theories: mapping the territory", Journal of Business Ethics, Vol. 53, pp. 51-71.
25. Gibbert, M., Ruigrok W., and Wicki B. (2008), "Research notes and commentaries", Strategic Management Journal, Vol. 29, pp. 1465-1474.
26. Ghauri, P., Kjell, Gronhaug, and Ivar K. (1995), Research methods in business studies: A practical guide, Prentice Hall.
27. Halme, M. (2007), "Something good for everyone? Investigation of three corporate responsibility approaches", working paper, Helsinki School of Economics, W-435, HSE Print 2007.
28. Harvey, B., and A. Schaefer (2001), "Managing relationships with environmental stakeholders, a study of U.K. Water and Electricity utilities", Journal of Business Ethics, Vol. 30 No. 3, pp. 243-260.
29. Hira, A., and Ferrie J. (2006), "Fair trade: three key challenges for reaching the mainstream", Journal of Business Ethics, Vol. 63, pp. 107-118.
30. Jones, P., Daphne C., and David H. (2005), "Corporate social responsibility and the UK's top ten retailers", International Journal of Retail & Distribution Management, Vol. 33 No. 12, pp. 882-892.

31. Ketola, T. (2006), "From CR-psychopaths to responsible corporations: waking up the Inner Sleeping Beauty of companies", Corporate Social Responsibility and Environmental Management, Vol. 13 No. 2, pp. 98–107.
32. Ketola, T. (2008), "A holistic corporate responsibility model: integrating values, discourses and actions", Journal of Business Ethics, Vol. 80, pp. 419-435.
33. Ketola, T. (2009a), "Five leaps to corporate sustainability through a corporate responsibility portfolio matrix", Corporate Social Responsibility and Environmental Management, published online in Wiley InterScience.
34. Linton,A., Cindy Chiayuan L., and Kelly Ann S. (2004), "A taste of trade justice: marketing global social responsibility via fair trade coffee", Globalization, Vol. 1 No.2, pp. 223-246.
35. Low, W., and Davenport E. (2005), "Has the medium (roast) become the message? the ethics of marketing fair trade in the mainstream", International Marketing Review,Vol. 22 No. 5, pp. 494-511.
36. Maloney, C. (2009), "The New Strategic Marketing Battleground: Corporate Social Responsibility" available at: http://dspace.scmsgroup.org/bitstream/handle/10562/1299/the-new-strategic marketing-battleground-corporate-social-responsibility.pdf?sequence =1 (accessed 12 July 2010).
37. Meehan, J., Meehan K., and Richards A. (2006), "Corporate social responsibility: the 3C-SR model", International Journal of Social Economics, Vol. 33 No. 5/6, pp. 386-398.
38. Mikkilä, M. (2005), "Observing corporate social performance empirically through the acceptability concept: a global study", Corporate Social Responsibility and Environmental Management, Vol. 12, pp. 183-196.
39. Moon, J. (2004), "Government as a driver of corporate social responsibility", International Center for Corporate Social Responsibility, research paper series, No. 20, ISSN 1479-5124.
40. Moore, G. (2004), "The fair trade movement: parameters, issues and future research",Journal of Business Ethics, Vol. 53, pp. 73-86.
41. Mountain Fruits (Pvt.) Limited. Official website [Online], available at http://www.fairtrade-dryfruits.com/index.htm.
42. Nicholls, A. J. (2002), "Strategic options in fair trade retailing", International Journal of Retail & Distribution Management, Vol. 30, No. 1, pp. 6-17.
43. Perk, H. (2006), "From Fair Trade to CSR", a paper contributed by Hans Perk, Manager, Solidaridad [Online]. Available at: http://www.intracen.org/WorkArea/DownloadAsset.aspx?id=51822 (Unpublished). (accessed 03 June 2010).
44. Phillips, R. (2003), "Stakeholder Theory and Organizational Ethics", Berret-Koehler Publishers, ISSBN 1-57675-268-2.
45. Raynolds, Laura T., Murray D., and Wilkinson J. (2007), Fair Trade: The Challenges of Transforming Globalization, first published by Routledge Taylor & Francis Groups, USA and Canada.
46. Reed, D. (2009), "What do corporations have to do with fair trade? positive and normative analysis from a value chain perspective", Journal of Business Ethics, Vol. 86, pp. 3-26.
47. Renard, M. C. (2003), "Fair trade: quality, market and conventions", Journal of Rural Studies, Vol. 19, pp. 87-96.

48. Saunders, M., Lewis, P., and Thornhill, A. (2007), Research methods for business students, England: Prentice Hall.
49. Spielman, B. (2000), "Organizational ethics programs and the law". Cambridge Quarterly of Healthcare, Vol. 9 No. 2, pp. 218-229.
50. Strong, C. (1996), "Features contributing to the growth of ethical consumerism-A preliminary investigation", Marketing Intelligence & Planning, Vol. 14, pp. 5-13.
51. Strong, C. (1997), "The role of fair trade principles within sustainable development", Sustainable Development, Vol. 5, pp. 1-10.
52. The Oke Impact (2006), AgroFair Europe B.V. 2006, Annual Report, available at:http://www.agrofair.nl/upload/File/AgroFair_Annual_Report_2006_secure_ENG.pdf (accessed 15 April 2010).
53. Ullmann, A. (1985), "Data in search of a theory: a critical examination of the relationships among social performance, social disclosure, and economic performance of US firms", Academy of Management review, Vol. 10 No. 3, pp. 540-57.
54. Valor, C. (2005), "Corporate social responsibility and corporate citizenship: towards corporate accountability", Business and Society Review, Vol. 110 No. 2, pp. 191-212.
55. Werther, W.B. Jr., and Chandler D. (2006), Strategic Corporate Social Responsibility: Stakeholders in a Global Environment, Sage Publications, ISBN-10:141291373X.
56. Windsor, D. (2001), "The future of corporate social responsibility", International Journal of Organizational Analysis, Vol. 9 No. 3, pp. 225-256.
57. WFTO (2009), "World Fair Trade Organization", available at http://www.wfto.com (accessed 20 March 2010).
58. Yin, R. K. (1994), Case Study Research: Design and Methods, 2nd Edition, Sage Publication Inc., California.
59. Yin, R. K. (2003), Case Study Research: Design and Methods, 3rd Edition, Sage Publication Inc., California.
60. Yin, R.K. (2009), Case Study Research: Design and Methods, 4th Edition, Sage Publication Inc.
61. Zadek, S., and Tiffen P. (1996), "Fair trade: business or campaign"? Development, Vol. 3, pp. 48-53.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

EMPLOYEES' THEFT BEHAVIOUR: A STUDY IN LARGE RETAIL ORGANISATIONS IN KUALA LUMPUR

M. Krishna Moorthy, Senior Lecturer, Faculty of Business and Finance, Universiti Tunku Abdul Rahman, Perak Campus, 31900, Kampar, Perak D.R., Malaysia
E Mail: krishnam@utar.edu.my

Felix Chee-Yew Ng, (Presenting Author), Senior Lecturer, Department of Accountancy, RMIT University, Vietnam
Email: felix.ngcheeyew@rmit.edu.vn

Mahendra Kumar a/l Chelliah, Lecturer and Head of Department, Department of Commerce & Accountancy, Faculty of Business and Finance, Universiti Tunku Abdul Rahman, Perak Campus, 31900, Kampar, Perak D.R., Malaysia
E mail: mahendra@utar.edu.my

King-Tak Yew, Senior Lecturer, Deputy Dean (Student Development and Industrial Training), Faculty of Business and Finance, Universiti Tunku Abdul Rahman, Perak Campus, 31900, Kampar, Perak D.R., Malaysia.
E Mail: yewkt@utar.edu.my

Lee Ah Suat, Lecturer, Faculty of Business and Finance, Universiti Tunku Abdul Rahman, Perak Campus, 31900, Kampar, Perak D.R., Malaysia
E Mail: leeas@utar.edu.my

ABSTRACT

Employee theft is one of the major factors of retail shrinkage despite many costly technological and widespread security measures. Employee theft cannot be ignored as it causes significant losses to employers. This study investigates the workplace factors that affect the employee retail theft behaviour. Although identifying theft is difficult, this study will help employers to further understand the retail employees' theft behaviour. This study was conducted in several large retail organisations in Malaysia's capital city, Kuala Lumpur. Data has been collected via questionnaire from 327 retail employees consisting managers, supervisors, retail employees and security personnel. The results showed that Compensation, Organisational Justice, Internal Control Systems and Punishment have a relationship with the Employees' Theft Behaviour. However, the Organisational Ethics did not influence the Theft Behaviour.

Keywords: Employee theft, retail theft, employee theft behaviour, workplace theft, Malaysia.

INTRODUCTION

Employee theft is defined as theft of anything of value from the employer by an employee or his/her accomplice. Methods include stealing merchandise, stealing cash, retaining receipts to show stolen items were paid for, voiding a sale or making a no-sale after a customer has paid and pocketing the cash, overcharging, short-changing, coupon stuffing, credits for non-existent returns and sliding product through the lane without charging (Mishra & Prasad, 2006).

The recent worldwide shrinkage survey named as The Global Retail Theft Barometer, 2011 (GRTB) conducted by the Centre for Retail Research, Nottingham, England for the year 2010-2011 revealed that 43.2% of the retail shrinkage was due to customer theft, 35.0% due to employee theft, 16.2% due to internal error and 5.6% due to suppliers-vendors frauds. As per the survey, total global shrinkage in the 43 countries surveyed costs retailers US$119.092 billion (US$119,092 million), equivalent to 1.45% of retail sales.

In The Global Retail Theft Barometer, 2011 survey, 20 Malaysian retailers with a combined sale of US$2.155 billion also participated. The findings of the survey revealed that as a percentage of total sales, retail shrinkage in Malaysia was 1.62 per cent, higher by 5.9% compared to 2009-2010, with a total shrinkage of US$271million. In this, the customer theft amounts to 51.2% (US$138.75 million) followed by employee theft at 23.3 % (US$63.14 million), administrative errors at 18.9% (US$51.22 million) and supplier or vendor theft at 6.6% (US$17.89 million). KPMG Malaysia Fraud Survey Report, 2009 revealed a total loss of RM63.95 million during 2006 to 2008 by the Malaysian companies due to employee fraud.

This study helps the employers to better understand the employees' theft behaviour so that the companies can recognise the intention of employees committing theft and solve the problem effectively.

RESEARCH OBJECTIVES

The research objectives of this study are:

- To determine the factors contributing to employees' theft behaviour in large retail organisations in Malaysia.
- To determine the most significant workplace factor that contributes to employees' theft behaviour in large retail organisations in Malaysia.

SIGNIFICATION OF THE STUDY

There are many empirical studies on theft in retail organisations in other countries. In the past, some studies had been carried out on workplace deviant behaviour in Malaysia, by Ku Ishak (2006); Kulas, McInnerney, Frautschy and Jadwinski (2007); Ahmad and Norhashim (2008); Finklea (2010); Omar, Halim, Zainah, Farhadi, Nasir, and Khairudin (2011); and Peng, Tseng and Lee (2011). The above literatures studied workplace deviant behaviour in total (Hollinger & Clark, 1982) which comprise of fraud and theft, vandalism, lying, spreading malicious rumours, withholding effort, aggressive behaviour, sexual harassment, property deviance, information deviance, and production deviance. Employee theft is only one of the above deviant behaviours; so, these literatures are inadequate to explain the

various factors contributing to workplace theft behaviour of employees in large-scale chain organisations. This study would provide insight on workplace factors that contribute to employees' theft behaviour in large size retail organisations in Malaysia.

THEORETICAL SUPPORT

Many theories have been developed and modified to identify the factors influencing the workplace theft behaviour. The Theory of Planned Behavior (TPB) would be used in this study to identify the factors that drives theft behaviour.

Theory of Reasoned Action (TRA) was developed by Icek Ajzen and Fishbein(1980). Later, their model was extended to Theory of Planned Behavior (TPB) by Icek Ajzen in year 1985. TPB is a theory that links attitudes and behaviours (Ajzen, 1991).

Initially, TRA was developed to examine the relationship between attitude and behaviour of a person. TPB was extended by Ajzen (1985, 1991) by incorporating perceived behavioural control since TRA was criticized that the model is neglecting the social factors that influences an individual's behaviour. Perceived behavioural control refers to a person's perceptions of how easy or difficult it is to engage in the particular behaviour. It addresses both internal control (e.g. persons's abilities) and external constraints (e.g. opportunities) needed to perform the behaviour (Ajzen, 1991).

TPB has been used in various studies to understand a number of different behaviours in which people engage. The theory has been applied by Ajzen and Driver (1992) to predict the relationship between leisure intention and the behaviour among a group of college students. They found evidence that the attitudes, subjective norms, and perceived control were predictive of leisure intentions among this group.

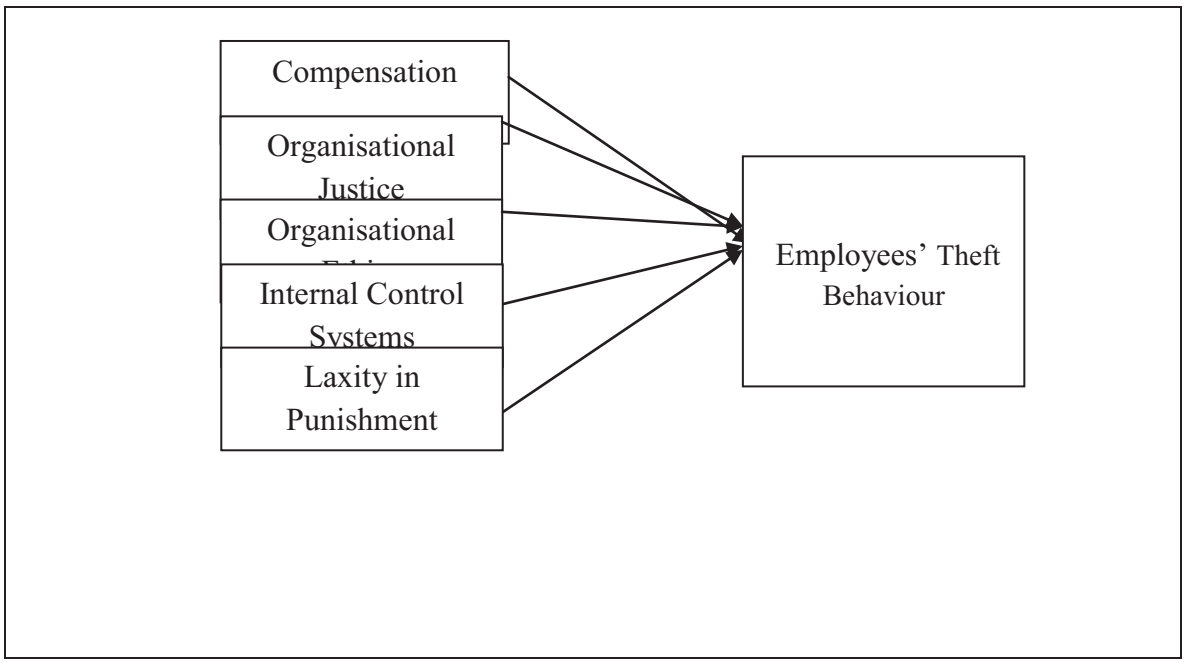
In 1992, Baxter, Manstead, Parker, Stradling, and Reason applied this theory in examining the driver's intention to engage in drinking and driving, speeding, close following and overtaking in risky circumstances. The findings of the model showed that perceived behavioural control can effectively predict the intentions to engage in these behaviours. Also, the model has successfully been applied in explaining such behaviours in employee use of information systems (Santhanam, 2002) and online grocery buying intentions (Hansen, Jensen, & Solgaard, 2004).

TPB theory has been used to assess the retail employee theft by Bailey (2006) and is widely used by the researchers to assess the unethical behaviours and thefts committed by people. Furthermore, TPB is used to explore the shoplifting behaviour by Tonglet (2002). She used this model with the intention to understand shoplifting behaviour and to determine the utility of TPB identification of the factors that led to it. She surveyed regular shoppers and students enrolled in two co-educational upper schools in the United Kingdom. The findings of the survey showed that the shoplifting behaviour is influenced by consumers' attitudes and views, social influence and perception of the risk of apprehension.

Lastly, retail employee theft is regarded as a volitional behaviour and this behaviour is likely to be influenced by people's perception, people's attitudes, normative beliefs and opportunities in engaging in this behaviour. So, TPB is appropriate to be applied in this study

to understand the employees' theft behaviour in large retail organisations in Malaysia. The employers are likely to have better understanding of the behaviour and factors contributing to such a behaviour.

CONCEPTUAL FRAMEWORK/RESEARCH MODEL



Source: Adapted from Employee Theft, Greenberg and Barling (1996)
Figure 1: The conceptual framework of workplace factors that influence the employee's theft behaviour in large retail organisations in Malaysia

This research aims to explain the relationship between the workplace factors and the employee's theft behaviour. Five hypotheses have been developed describing the relationship between the five workplace factors (compensation, organisational justice, oraganisational ethics, internal control systems and laxity in punishment) and employees' theft behaviour.

The target population consists of employees of large retail organisations in Kuala Lumpur, Malaysia. Due to the wide geographical coverage of the large retail organisations in Kuala Lumpur and huge number of retail employees, a sample of 325 managers, retail employees, supervisors, and security personnel of large retail organizations are studied.

RESEARCH INSTRUMENT

Questionnaire

The 40 questions questionnaire consisting of 7 parts begins with demographic profile followed by Part A: Compensation (Com), Part B: Organisational Justice (OJ), Part C: organisational Ethics (O E), Part D: Internal Control Systems (ICS), Part E: Laxity in Punishment (LP), lastly Part F: Employee's Theft Behaviour (ETB).

The independent variables are adapted from Greenberg (1990, 1993); Greenberg and Barling (1996); Kamp and Brooks (1991); Drinkard (1996) and Bandura (1986). Ordinal data is used as the scale of measurement for the variables. All items are measured on a five point Likert-scale, ranging from 1, strongly disagree to 5, strongly agree.

Pilot Test

Prior to the actual survey, a pilot test **has been** conducted with 30 managers, retail section employees, supervisors, and security personnel of large retail organisations in Kuala Lumpur to assess their understanding towards the questions aiming to ensure that there are no unclear items in the questionnaire and to guarantee the content validity of the research.

Table 1: Reliability Statistics for 30 respondents for pilot test

Variables	Cronbach's Alpha	No of items
Compensation	0.947	5
Organisational Justice	0.885	5
Organisational Ethics	0.947	5
Internal Control Systems	0.709	5
Laxity in Punishment	0.825	5
Employee's theft behaviour	0.927	7

Source : Developed for the research

Data collection procedure

After being satisfied with the pilot study results, 500 questionnaires were distributed to the managers, supervisors, retail section employees and security personnel in large retail organisations in Kuala Lumpur following convenience sampling they were selected because they carry out the daily operations and they are more familiar with the environment of the organisation. Thus, their responses **are** believed to be useful and reliable for this research. Out of 500 questionnaires distributed, 342 questionnaires **have been** received back. After removing the outliers, only 327 questionnaires were used for the analysis.

Data Analysis

Subsequently after collecting the data, SPSS17.0 was used to analyse the responses obtained. The analysis includes reliability test, normality test, Pearson correlation coefficient and multiple regression analysis. Descriptive statistics describe the main features of a collection of data quantitatively (Mann, 1995). Descriptive analysis is the transformation of raw data into a form that is easily understandable and interpretable. The common method used are calculating averages, frequency distribution and percentage distribution that are used in this research, followed by the Cronbach's alpha reliability coefficient to show how well the set of data are positively correlated to one and another .Next is the Pearson correlation coefficient and Multiple Regression Analysis (MRA) to answer cause-and-effect questions and make predictions. The significant level *(p)* in Pearson's Correlation Coefficient test in this study is 0.05 which means the confidence level is 95%. Hypothesis is rejected if the *p*-value is more

than 0.05 based on the results obtained from MRA as there is enough evidence to reject. While the general form of MRA will use a statistical method that simultaneously builds up a relationship between two or more independent variables with a dependent variable with the formula: $Y = \alpha + \beta 1x1 + \beta 2x2 + \cdots \beta nxn + \varepsilon$.

Results and Discussion

The results obtained are divided into four sections beginning with the descriptive analysis, whereby the demographic characteristics, central tendencies measurement are presented. Next is the scale measurement analysis showing the outcome of the reliability analysis and normality analysis, followed by the inferential analysis which includes Pearson correlation analysis and Multiple Regression Analysis (MRA)

Demographic profiles

The majority of the respondents are female (63.4%), and the rest of the respondents are male (36.6%). 36.6% of the respondents are below the age of 20, followed by 25.2% of people in the age group of 21-30, 16.4% in the age group of 31-40, 18.5% in the age group of 41-50 and lastly 3.4% in the age group of 50 and above.

47.1% respondents have a monthly gross income of RM500- RM1000, followed by 27.3% of people with the gross of RM1001- RM1500, 14.3% with gross income of RM1501-RM2000, 9.7% with an income below RM500 and lastly 1.3% above RM2000.

The majority of the respondents are Chinese with 50.1%, followed by 39.8% of Malays and 10.1% of Indians. Most respondents have an educational level of SPM (56.7%), followed by 23.1% below SPM level, 16.8% with a bachelor degree and 3.4%of diploma holders. On the average 56.7% of the respondents period of employment is currently below 1 year, followed by 1-3 years with 26.1%, 3-5 years with 18.1% and lastly 5 years and above with 6.7%. Concluding the demographic profile is the employment type question with two choices part time and full time employment, with 2.7% being part time while full time was 97.3%.

Reliability test

The research started with testing the reliability of the data to test the consistency and satiability of the data. The Cronbach's alpha of the six variables combined is 0.921, while the individual variables Cronbach's alpha ranges from 0.700-0.947. Thus the internal consistency reliability of the variables used in the study is considerably good according to Sekaran's (2000) rule of thumb.

Table 2: Results of Reliability Analysis for final data

Contructs	Cronbach's Alpha	Number of items
Compensation	0.803	5
Organisational Justice	0.700	5
Organisational Ethics	0.947	5
Internal Control Systems	0.702	5
Laxity in Punishment	0.822	5
Employee Theft Behaviour	0.805	7

Source: Developed for the research

Normality test

Normality test has been carried out to ensure that there is no outlier in the data since the outliers will distort the normality of the data. There are some outliers appeared from the data collected, hence from the data collected, 15 outliers were removed to ensure the data is free from outliers.

Pearson correlation

The results showed a positive correlation between Compensation, Organizational Justice, Organisational Ethics, Internal Control Systems, Laxity in Punishment and employee theft behaviour. The highest correlation against the dependant variables is between Laxity in Punishment and Employees' Theft Behaviour (0.783), followed by Internal Control Systems (0.599), Compensation (0.548), Organizational Justice (0.432), and Organisational Ethics (0.358). No multicollinearity of independent variables is noticed.

Multiple Regression Analysis

Table 3: Results of Regression Analysis

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.496	.165		3.008	.003		
	AVGCOM	-.239	.038	-.240	-6.317	.000	.444	2.252
	AVGOJ	-.204	.033	-.179	-6.263	.000	.787	1.271
	AVGOE	.596	.034	.732	17.568	.072	.370	2.700
	AVGICS	-.723	.038	.572	19.194	.000	.725	1.379
	AVGPUN	.422	.032	.456	18.123	.012	.540	2.232

a. Dependent Variable: AVGETB

R Square 0.6521
F Value 39.7
P value for the model 0.011

Source: Developed for the research

The results of MLR showed a good model fit with F value 39.7 with overall model fit p value of 0.011. The four independent variables (other than Organisational Ethics which is not significant) jointly influence 65.21% of variation in the dependent variable.

Summary of statistical analysis

Table 4: Summary of statistical analysis

Hypothesis	Supported	Result
H1: There is a negative relationship between Compensation and employees' theft behaviour	Beta: - 0.239 Sig: 0.000	Supported
H2: There is a negative relationship between Organisational Justice and employees' theft behaviour	Beta: -0.204 Sig: 0.000	Supported
H3: There is a negative relationship between Organisational Ethics and employees' theft behaviour	Beta: - 0.596 Sig: 0.072	Not Supported
H4: There is a negative relationship between strong Internal Control Systems and employee's theft behaviour	Beta: -0.723 Sig:0.000	Supported
H5: There is a positive relationship between laxity in punishment and employees' theft behaviour.	Beta: 0.422 Sig: 0.012	Supported

Source: Developed for the research

The results show that the Internal Control Systems are more significant workplace factor in influencing the Employees' Theft Behaviour.

Limitations of the study

The sample size is a limitation as it lacks geographical coverage to search a wider range of respondents because of financial constraint and time, therefore this study's sample size is only limited to Kuala Lumpur which lead to the findings of the research inaccurate to be generalized as it is not based on all states in Malaysia.

This research is only based on large retail organisation, but small and medium organisations are also affected by employee theft but not represented.

The individual factors such as need, opportunity and personal characteristics were not considered.

Managerial Implications

The present study of employees' theft behaviour makes several noteworthy contributions towards retail operations in Malaysia. It is a major source of shrinkage for many retailers. Hence this study would help to shed some light to this observable fact that should not be taken lightly. Prior to seeking strategies to overcome the problem, the driver of such behaviours should be determined.

This research proposed variables such as Compensation and Internal Control Systems to show how they significantly influence the employee's retail theft. If these drivers are established, it would help the large retail management team to have a sound pay and compensation policy and a solid internal control system. The management team should also try to give the organisation more fair and justice to all levels of employees and additionally give a severe punishment for the employees who involve in theft. Although these drivers may have an adverse effect, but if with due care could actually work to the advantage of the management.

Theoretical Implications

With a good model fit and by accepting four hypotheses out of five, the study also supported the Theory of Planned Behaviour.

Recommendations

A longitudinal study should be conducted so that the time constraint could be eliminated and a more in depth study could be conducted, as employee theft could take time to be minimized, or better eliminated. Besides that, changes in technology and other variables not included could be tested and taken into account.

Small and medium organisations should also be included for further study as these organisations are also affected with thieving and dishonesty of employees. A study including small and medium retail organizations could really help the managers of those organisations to understand the behaviour and choose a suitable internal control system to help curb the employee's retail thieving problem.

Individual factors should also be included to analyse the employee theft behaviour.

CONCLUSION

Employee's theft has been increasing year after year. It is a significant source of retail shrinkage and needs to be addressed and prevented, as employees are family members to the organisation, having such betrayal, in actual fact shows disloyalty. Furthermore retail establishment is losing an immense amount of money, to the tune of $266million a year because of theft and 3.9% of it is reported to be from employees. Hence this is an issue which warrants both academics' and practitioners' attention.

REFERENCES

1. Ahmad, Z., and Norhashim, M. (2008). The Control Environment, Employee Fraud and Counterproductive Workplace Behaviour:An Empirical Analysis, Communications of the IBIMA, 3, 145-155.
2. Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. Action Control: From Cognition to Behavior, 11-39.
3. Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50, 179-211.
4. Ajzen, I., and Driver, B. L. (1992). Application of the theory of planned behavior to leisure choice. Journal of Leisure Reseach, 24(3), 207-224.
5. Ajzen, I., and Fishbein, M. (1980). Understanding attitudes and predicting social behavior. Englewood Cliffs, NJ: Prentice-Hall.
6. Bailey, A. A. (2006). Retail employee theft: A theory of planned behaviour perspective. International Jounal of Retail & Distribution Management, 34(11), 802-816.
7. Bandura, A. (1986). Social Foundations of Thought and Action: A Social Cognitive Theory. Englewood Cliffs, NJ: Prentice-Hall.
8. Baxter, J. S., Manstead, A. S. R., Parker, D., Stradling, S. G., and Reason, J. T. (1992). Perceived consensus in eliminates of driving errors and violations. Journal of Applied Social
9. Psychology, 22, 509-530.
10. Drinkard, L. (1996), Silent theft. Restaurants & Institutions, 106(6), 116-117.
11. Finklea, K.M. (2010). Identity Theft: Trends and Issues. Congressional Research Service, January, 2010.
12. Greenberg, J. (1990). Employee theft as a reaction to underpayment inequity: The hidden cost
13. of pay cuts. Journal of Applied Phychology, 75(5), 561-568.
14. Greenberg, J. (1993). Stealing in the name of justice: Informational and interpersonal moderators of theft reactions to underpayment inequity. Organizational Behavior and Human
15. Decision Process, 54, 81-103.
16. Greenberg, L., and Barling, J. (1996). Employee theft. Trends in Organizational Behavior, 3, 49-65.
17. Hansen, T., Jensen, J., and Solgaard, H. S. (2004). Predicting online grocery buying intention:A comparison of the theory of reasoned action and the theory of planned behavior. International Journal of Information Management, 24(6), 539-550.
18. Hollinger, R. C., and Clark, J. P. (1982). Formal and informal social controls of employee deviance. Sociological Quarterly, 23, 333-343.
19. Kamp, J. and Brooks, P. (1991), Perceived organizational climate and Employee Counter Productivity. Journal of Business and Psychology, 5, 447-458.
20. KPMG Malaysia Fraud Survey Report, 2009.
21. Ku Ishak, A.B. (2006). The Relationship between deviant behaviours of MARA Employees in Northern Malaysia with its predictors, Unpublished master thesis, Universiti Utara Malaysia.
22. Kulas, J.T., McInnerney, J.E., Frautschy deMuth, R., and Jadwinski, V. (2007). Employee Satisfaction and Theft:Testing Climate Perceptions as a Mediator. The Journal of Psychology, 141(4), 389-401.
23. Mann, P. S. (1995). Introductory statistics. New York: John Wiley and Sons Inc.

24. Mishra, B. K., and Prasad, A. (2006). Minimizing retail shrinkage due to employee theft. International Journal of Retail & Distribution Management, 34(11), 817-832.
25. Omar, F., Halim, A.Z., Zainah, A.Z., Farhadi, H., Nasir, R and Khairudin (2011). Stress and Job Satisfaction as Antecedents of Workplace Deviant Behaviour. World Applied Sciences Journal, 12, 46-51.
26. Peng,, J., C. Tseng, M., M. and Lee Y. L. (2011), Relationships Among Supervisor Feedback Environment, Work-Related Stressors, and Employee Deviance, Journal of Nursing Research, 19(1), 13-24.
27. Santhanam, R. (2002). Improving Training Outcomes Using Pre-Training Scripts: A Theory of Planned Behaviour Approach, Information & Organization, 12(3), 135-52.
28. Sekaran, U., (2000). Research Methods for Business: A Skill Building Approach, New York: John Wiley & Sons, Inc.
29. The Global Retail Theft Barometer, 2011, Centre for Retail Research, Nottingham, United Kingdom.
30. Tonglet, M. (2002). Consumer misbehaviour: An exploratory study of shoplifting. Journal of
31. Consumer Behavior, 1(4), 336-354.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

AEC AND THAILAND BRAND

**Yupin Patara, SASIN Graduate Institute of Business Administration,
Chulalongkorn University, Thailand
Email: yupin.patara@sasin.edu**

**Nicha Tanskul, SASIN Graduate Institute of Business Administration
Chulalongkorn University, Thailand**

ABSTRACT

Situation: *Thailand will become part of AEC in the next 1-2 years. By becoming part of AEC there will be no trade barrier. Hence, as a result, Thai Brand or Thai Manufacturers will be facing with fiercer competition from the influx of foreign products.*

Motivation: *This paper is aiming at finding the way to support Thai products/manufacturers when it is not ready to compete with other products from AEC countries by utilizing the concept of ethnocentrism and animosity as well as cultural collectivism as a protection against the influx of other countries. Previous study has shown that people with higher ethnocentrism will have less favorability towards foreign product when the product is unnecessary. While, country of origin may have influence towards necessary product, nevertheless, animosity can reduce the preference towards that necessary product that is highly value in terms of country of origin in other country.*

Study Design: *Two experimental study will be conducted with the convenient samples, students subjects.*

- *Study 1: Between Subject Design: 2(Ethnocentrism: National Anthem vs. Control) X 3(Animosity: Animosity vs. Domestic Animosity vs. Anti-Domestic Animosity or Unity (Olympic))*
- *Study 2: Between Subject Design: 2(Ethnocentrism: National Anthem vs. Control) X 3(Animosity: Animosity vs. Domestic Animosity vs. Anti-Domestic Animosity or Unity (Olympic)) X 2(Culture: Independence Self vs. Interdependence Self)*

Product

- *The product that consumer will be evaluated will be composes of 2 categories which are necessary and non-necessary category*
- *The price would be manipulated such that local product is higher than international product*

Measurements:

- *Preference toward Thai Brand in Non-Necessary Category (Julie Cracker vs. Farmhouse Cracker)*
- *Preference toward Thai Brand in Necessary Category (Thai Rice vs. Cambodian Rice)*
- *WTP for Thai Brand vs. International Brand*
- *Manipulation on Price make International brand more expensive than local brand*

Manipulation Check

- *CETS (Shimp)*
- *Animosity (Kline & Ettenson)*
- *Inter/Independent Self*

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE IMPORTANCE OF BUILDING AND REBUILDING TRUST IN ORGANIZATIONS

Joanna Paliszkiewicz, Warsaw University of Life Sciences

ABSTRACT

Purpose: *Trust is important, because it allows people to form relationships with others and to depend on others—for love, for advice, for help. But trust also involves the risk that people they trust will not pull through for them.*
The aim of the article is to present empirical research connected with building and rebuilding trust in organization and to present method to measure level of trust in organization.
Design/methodology/approach: *In the article the research, which was done in the best Polish enterprises form Mazovia Province are presented. This work was supported by Ministry of Science and Higher Education in Poland. Article is connected with the realization of research project entitled "Orientation on trust and organizational performance" (No. N N115 549238).*
Findings: *In the article the approach to measure level of organizational trust is proposed. The study shows the connection between orientation of trust and organizational performance.*
Research limitations/implications: *The research was done in the best polish enterprises, so the research should be also made in other kind of enterprises.*
Originality/value: *The topic of trust is very important now, in the era of crisis. It is the first method of measuring trust level, which was checked in polish enterprises.*

Keywords: Trust, trust management, building trust, rebuilding trust

INTRODUCTION

The concept of trust is very important in all sphere of human life, especially now, in the era of global crisis. Trust enables people to feel more safety in the very fast changing world. To strengthen society and its major foundations, we need to build and rebuild trust. Nowadays, trust has decline for many reasons, and some of these have persisted for decades. This include societal issues, such as increasing suspicion due in part to decrease interaction among individuals, and institutional factors, such as the recent massive failures in the financial system or organizational malfeasance. Additionally, we can add violations of trust by many business, governmental, and religious leaders.

Trust is essentially important for successful cooperation and effectiveness in organizations, facilitates negotiations, reduces transaction costs, and even help to resolves international political conflicts. Trust enhances the ability to change and to support radical change. This is because trust is said to assist in learning, creativity and innovation.

The aim of the article is to show the importance of trust building and rebuilding and to indicate the relationship between trust in organization and organizational performance. The research was done in enterprises from Poland.

Building and rebuilding trust

Building trust in the organization plays an important role. Trust facilitates management, risk taking, effective use of resources as well as the impact on all activities of the organization. Previous research has shown that leaders are critical to build trust in organizations, and that trust in leaders is significantly related to a number of attitudes, behaviours, and performance outcomes.

Preparation to start effective process of building trust in the organization should begin from diagnose the situation in the organization. R. K. Sprenger (2009) suggests using the following questions, which can help in the diagnosis:

- What managers do to promote a culture of trust in a company?
- What criterias of behavior in organizations allow us to understand the culture of trust?
- What relevant subjects or objects of trust are in organization?
- What are the biggest obstacles of building a climate of trust in the company?
- Which of the rules in organization are the opposite of trust?
- How climate of trust is creating among the leaders?

Managers should diagnose whether the current business is based on trust or not. (hidden) E. M. Whitener, S. E. Brodt and J. M. Werner (1998) suggested that the existence of trust in the organization need the following behavior of managers: consistency in performance, integrity in action, proper communication, show of interest to employees. Example and support in building a climate of trust has to start from the management, but the attitude of the staff are also important. We can specify the appropriate behavior on the side of workers such as: tell truth, responsible behavior, effective communication, support to other staff, information about irregularities in the organization and organizational processes, a sense of responsibility for the success of the organization.

In the literature there are a lot of propositions of activities which influence of building trust in organization for example:

- Providing information - just in time (Deutsch 1973; Ellinor, Gerard 1998; Ryan, Oestreich 1998);
- Giving positive and negative feedback to staff in an appropriate manner (Zand 1972; Johnson, Johnson 1995; Ryan, Oestreich 1998);
- Speaking openly about problems (Deutsch 1973; Gabarro 1978);
- Being honest to others (Deering, Murphy 1998);
- Initiate and accept changes in decisions in they are needed (Zand 1972; Johnson, Johnson 1995; Ryan, Oestreich 1998);
- Listen and accept advice of other people (Zand 1972; Gabarro 1978; Ryan, Oestreich 1998);
- Giving and receiving help and support (Deutsch 1973; Johnson, Johnson 1995; Ryan, Oestreich 1998);
- Showing interest and caring for others (Deutsch 1973);
- Delegating responsibilities to personnel (Zand 1972; Zand 1997, Deutsch 1973; Costigan, Ilter, Berman, 1998; Nelson, Cooprider, 1996);
- Delivering on promises and telling the truth (Deluga 1994; Hosmer, 1995; Humphrey, Schmitz 1998; Jones, George 1998; Karsgaard, Schweiger, Sapienza 1995);

- Showing respect to others (Costigan, Ilter, Berman 1998; Nelson, Cooprider 1996);
- Demonstrating loyalty and job satisfaction (Bigley, Pearce, 1998; Sabherwal 1999).

In the literature there are some proposition of model of organizational trust building. For example R. Galford i A. S. Drapeau (2002) proposed model SEEKER consisted of the following elements:

- **S**how that you understand the needs of individuals and groups;
- **E**stablish the rules;
- **E**xplain what resources are available to use;
- **K**eep promises;
- **E**ngage in communication;
- **R**einforce others by proper behaviour.

M. Armour (2007) confirmed that building trust should focus on four factors: climate, character, behavior, and culture. First, leaders must create a climate of trust, so that employees feel: safe, informed, treated with respect, valuable to organization and understood (**S**afe, **I**nformed, **R**espected, **V**alued, **U**nderstood – SIRVU). Trust will develop in the employees if they meet leaders of the following characteristics: **H**umility, **I**ntegrity, **T**ruth, **R**esponsiveness, **U**nblemished fair play, **S**upport and encouragement, **T**eam care (HI-TRUST).

Costs of loss of trust affect different areas of the organization. It all depends on what kind of trust has been destroyed. Loss of trust is associated with negative emotions of people such as: anger, fear, which strongly affect humans (Solomon, Flores 2001). According to R. J. Bies and T. M. Tripp (1996) loss of trust can be defined as a situation where the perceived hoping that he/she trusted did not meet its expectations. For example the lost of organizational trust can be connected with (Gibb 1991; Shockley-Zalabak, Morreale, Hackman 2010):

- Errors in the formulation of strategy and unclear vision of action,
- Changes, acquisitions, restructuring, redundancies,
- A breach of ethics,
- Political environment,
- Lack of communications,
- Unclear policy of the organization,
- Exerting pressure on the workforce,

The costs of trust lost are related to: broken reputation, negative attitude to work, negative thinking, making bad decisions and decreasing of income.

Rebuilding trust to the leaders or the organization is a very difficult process, and in some cases even impossible. Studies on the breach of trust are carried out in the context of interpersonal (Lewicki, Bunker 1996; Sitkin, Roth 1993) and social (Shapiro 1987; Zucker 1986).

The first step leading to rebuild trust is to admit to mistakes. Then, propose amendments taking into account the views of all interested parties. Trust must be rebuilt in a natural way. It cannot be a result of the transaction. You cannot force anyone to trust. Each party must demonstrate good will and recognize the needs of others.

Restoring confidence in the organization is a process which can be influenced mainly by the action in the area of development and non-financial incentives.

Examples of such activities include:

- Participation in non-standard and / or strategic projects;
- Increasing autonomy resulting from increasing participation in decision-making;
- Closer contact with senior staff;
- Giving support from mentors;
- Improve access to critical business information.

Presented examples do not require financial investment and only a deep commitment of executives. Efforts should first be concentrated on key employees, because at the labor market they can find better position. The rebuilding of trust can also be better when managers will be train in soft skills such as empathy, communication, coaching. The trust is important not only in organization but also in contacts with business partners, clients and society.

METHODOLOGY

Instrumentation

Three questionnaires were used - Measures of Organizational Trust Questionnaire Measures of Managers Trust Questionnaire and Measure of Organizational Performance Questionnaire. In these three questionnaire five point Likert scale was used (strongly agree = 5, agree = 4, neither agree nor disagree = 3, disagree = 2, and strongly disagree = 1).

Measures of Organizational Trust Questionnaire and Measures of Managers Trust Questionnaire were proposed by Paliszkiewicz based on a review of literature that included research studies of R. P. Barraglio, S. E. Condrey (2009); C. Caldwell, S. E. Clapham (2003); A. M. Evans, W. Revelle (2008); S. Gächter et al. 2004; E. L.Glaeser et al. 2000; K. Jones, L. N. K. Leonard 2008, P. Kanawattanachai, Y. Yoo (2002); and R. Seppänen et al. 2007. In Organizational Trust Questionnaire the items were as follows:

1. There is atmosphere for honest cooperation among employees.
2. Clear expectation connected with results and aims from all employees.
3. Employees are willing to share knowledge.
4. Employees openly admit and take responsibility for the mistakes they have made.
5. Employees avoid participating in gossip and unfair criticism of others.
6. Employees are willing to take part in trainings.
7. Periodic meetings take place between employees and the management.
8. In general the work responsibilities are established and clear.
9. The criteria of promotion are clear in every position.
10. Evaluation of employees is fair.
11. The relationship between employees is good.
12. All employees are treated fairly
13. The interests of workers are taken care of.
14. Team work is encouraged and preferred.
15. Employees are encouraged to take part in decision-making.

Measure of Managers' Trust Questionnaire:

1. In dealing with people never be too careful
2. You should not trust other people until you do not know them well
3. Most people will lie if it will then be able to get something
4. Employees in your company when the opportunity arises to gain something will be dishonest
5. In these days in your company you can only count on yourself and only trust yourself
6. Relations between employees are connected with rivalry
7. Employees in your company wish other the best
8. Most people in your company keep promises
9. In your company a new ideas are implement and work conditions are improved
10. In your company people can open discuss what is wrong
11. In your company your employees feel accountable for their tasks and do not have to be monitored
12. In your company staff for most of the time trying to be helpful to others and do not care only about self-interest
13. In your company motivation of people is high
14. In your company managers are mostly advisors and intellectual partners to employees
15. In your company the innovativeness, taking risk and originality are preferred

In case of questions from 1 to 6 (measure of manager's orientation on trust) the scale was changed that 5 was always the good answer.

Measure of Organizational Performance Questionnaire was used to measure organizational performance. This questionnaire is based on the work of R. Deshpande, U. Jarley, F. Webster (1993) and S. Drew (1997). This measure can be thought of as a variation of the balances scorecard method. The organizational performance is assessed by the use of global output measures such as market share, profitability, growth rate, and successfulness in comparison with key competitors. J. Paliszkiewicz (2007) modified this questionnaire to include the dimension of innovativeness. The items were as follows:

1. In comparison with the competitors, this company is more profitable.
2. In comparison with the competitors, this company has a larger market share.
3. In comparison with the competitors, this company is growing faster.
4. In comparison with the competitors, this company is more innovative.
5. In comparison with the competitors, this company is more successful.
6. In comparison with the competitors, this company has lower costs.

SUBJECTS AND PROCEDURE

The questionnaires were distributed to 469 managers (205 – upper management, 203 middle management, 61 – lower management) from 287 companies identified as the best enterprises according to the Forbes Journal in Mazovia Province in 2009. The research took place in the enterprises from the Mazovia Province in Poland from November 2010 to February 2011.

DATA ANALYSIS AND RESULTS

Collected data were analyzed using a k-means clustering method. In data mining, ***k*-means clustering** is a method of cluster analysis which aims to partition n observations into k

clusters in which each observation belongs to the cluster with the nearest mean. Euclidean distance was used as a metric and variance was used as a measure of cluster scatter.

For this method three dimensions were used: managers' orientation on trust (OM), organizational orientation on trust (OP) and organizational performance (WD). Manager's orientation on trust and organizational orientation on trust were measure in the scale from 15 to 75 and organizational performance from 6 to 30. The results are presented at the figure 1.

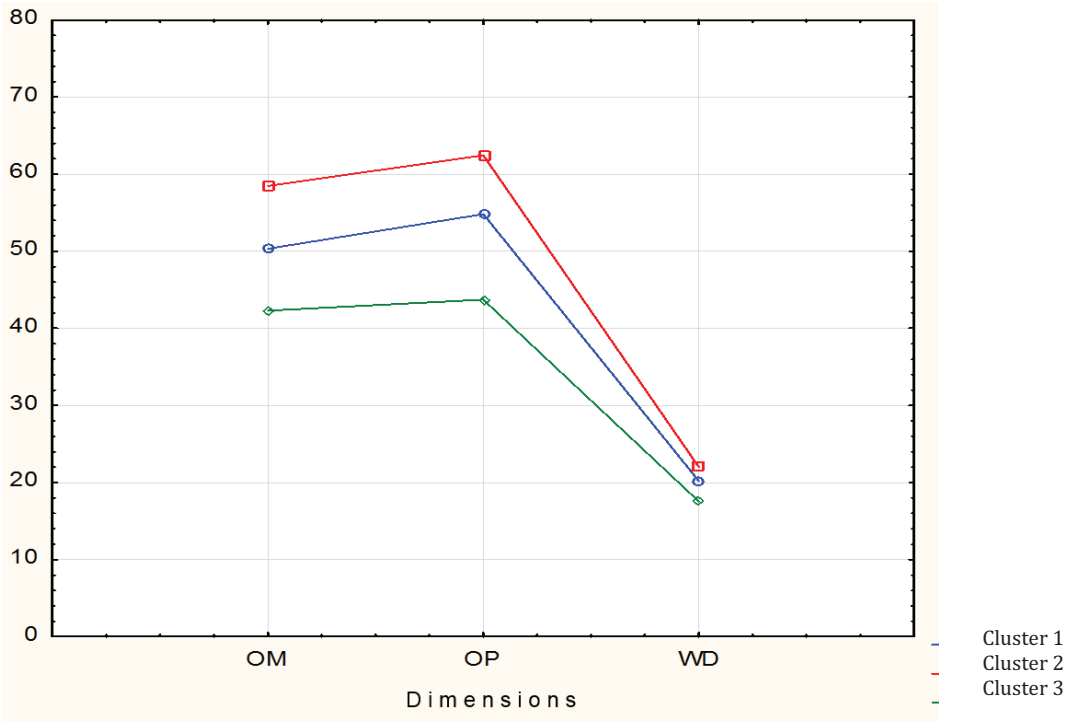


Fig. 1. K-means clustering method – 3 dimensions
Source: Author's research

According to the research the best results have enterprises in cluster 2, the worst in cluster 3. To first cluster 226 respondents were classified. Characteristic of the group is presented in table 1.

Table 1. Descriptive statistics – cluster 1

	Means	Standard deviation	Variance
OM	50,33	3,86	14,92
OP	54,81	3,44	11,85
WD	20,21	3,46	12,00

Source: Author's research

In cluster 1 the average orientation of managers on the creation of trust is 50.33, and is lower than the average of the whole population that is 55.93. Orientation companies to create trust are higher than average (52.10) and is 54.81. Average organizational performance is 20.21.

Descriptive statistics for the best cluster 2 are presented in the table 2. In this group there are 172 respondents.

Table 2. Descriptive statistics - cluster 2

	Means	Standard deviation	Variance
OM	58,47	4,37	19,10
OP	62,44	4,38	19,17
WD	22,02	3,68	13,53

Source: Author's research

In the cluster 2 the average orientation of the managers on the creation of trust and the average orientation of the company for the creation of trust is above the average calculated for the entire study population (OM is 58.47 and OP is 62.44).

In cluster 3 there are 71 respondents. Descriptive statistics are presented in table 3.

Table 2. Descriptive statistics - cluster 3

	Means	Standard deviation	Variance
OM	42,29578	5,119694	26,21127
OP	43,71831	5,926172	35,11952
WD	17,54930	4,771309	22,76539

Source: Author's research

The respondents in cluster three have the weakest results, both the average orientation of the managers on the creation of trust and the average level of orientation for the creation of trust companies is below average. Respondents also see the results of organizational performance as lower.

The results tend to create a few important conclusions of a theoretical nature. Research confirms the existence of a link between the orientation of the company to create trust and orientation of the managers on the creation of trust and the organizational performance. Trust is an important resource of the company and there is no substitute. Better results are achieved in organization when the orientation of the trust is higher in the two studied categories. The study also revealed the possibility of complete deprivation of resources by increasing trust seen as factor influencing on organizational performance.

SUMMARY

Trust allows to coordinate cooperation between partners who are and remain strangers to each other, and they do not know each other. It replaces the knowledge of other people and motives them to take actions. If ambitious economic goals have to be achieved we must trust to those who do not know personally. This is a problem for many people.

According to the research orientation on trust in companies in Poland is not high, it can be compare to the trust that is diagnosed for the whole country. Highest trust now declare young people between 18 and 34 years of age, people with higher education and well-paid. It may be concluded that over the years, when there will be a change of generations trust in our society increases, which should also have influence on economic performance of the whole society.

In organizations, managers often do not realize the role of trust and its impact on results of operations. But there are a lot of advantages connected with building trust culture:

- Integration of the company: efficient communication, effective implementation of change (eg, during the crisis) and effective and efficient management teams;
- Improve performance and increase competitiveness;
- Increase innovation by stimulating creativity, creating new ideas and intellectual potential of the employees;
- Increase in employee development. In an atmosphere of trust, people are more willing to share their knowledge;
- More effective management of human resources processes, e.g. recruitment and selection, adaptation, development, training, motivating, evaluating and rewarding employees;

From a practical point of view, the research showed the managers of enterprises, that management of trust is essential in the development of business and getting better results. The results showed that even in the best Polish companies is still much to do in terms of raising the level of trust. The results may encourage managers to follow companies with high trust level, and to build their own unique strategy for trust management. The companies could monitor the level of trust using the specially prepared tools such as proposed in this article questionnaire.

The results inspired to ask the following research questions for the future study: How trust is dependent on the characteristics of individuals or organizational culture? How does it happen that the trust will expire in a particular organization? How to rebuild trust in a particular organization? How to develop confidence in multicultural environments?

ACKNOWLEDGEMENT

This work was supported by Ministry of Science and Higher Education in Poland. Article is connected with realization of research project entitled “Orientation on trust and organizational performance” (No. N N115 549238).

REFERENCES

1. Armour, M. (2007), Leadership and the Power of Trust. Creating a High-Trust Peak-Performance Organization, Life Themes Press, Dallas.
2. Barraglio, R.P., Jr., Condrey, S.E. (2009), “Reforming Public Management: Analyzing the impact of public service reform on organizational and managerial trust”, Journal of Public Administration Research and Theory, No. 19, pp. 689–707.

3. Bies, R.J., Tripp, T.M. (1996), "Beyond distrust, „getting even" and the need for revenge", Kramer R.M., Tyler T.R., (Eds.), Trust in Organizations: Frontiers of Theory and Research, Thousand Oaks, CA, Sage, pp. 246-260.
4. Bigley, G.A., Pearce, J.L. (1998), "Straining for shared meaning in organization science: problems of trust and distrust", Academy of Management Review, No. 23 (3), pp. 405-422.
5. Caldwell, C., Clapham, S.E. (2003), "Organizational Trustworthiness: An international perspective", Journal of Business Ethics, No. 47, pp. 349–364.
6. Costigan, R.D., Ilter, S.S., Berman, J.J. (1998), "A multi-dimensional study of trust in organizations", Journal of Managerial Issues, No. 10 (3), pp. 303-318.
7. Deering, A., Murphy, A. (1998), The difference engine, achieving powerful and sustainable partnering, Aldershot, Gower.
8. Deluga, R.J. (1994), Supervisor trust-building, leader-member exchange and organizational citizenship behavior, Journal of Occupational and Organizational Psychology, No. 67, pp. 315-326.
9. Deshpande, R., Jarley, U., Webster, F. (1993), "Corporate culture, customer orientation, and innovativeness in Japanese firms: A quadrat analysis", Journal of Marketing, No. 57 (1), pp. 23-37.
10. Deutsch, M. (1973), The resolution of conflict: constructive and destructive processes, Yale University Press, New Haven.
11. Drew, S. (1997), "From knowledge to action: The impact of benchmarking on organizational performance", Long Range Planning, Vol. 30 No. 3, pp. 427-441.
12. Ellinor, L., Gerard, G. (1998), Dialogue, rediscover the transforming power of conversation, John Wiley, New York.
13. Evans, A.M., Revelle, W. (2008), "Survey and Behavioral measurements of Interpersonal Trust", Journal of Research in Personality, No. 42, pp. 1585–1593.
14. Gabarro, J. J. (1978), "The development of trust, influence and expectations", Athos A. G., Gabarro J. J., (Eds.), Interpersonal behavior, communication and understanding in relationships, Prentice-Hall, Englewood Cliffs, pp. 290-303.
15. Gächter, S., Herrmann, B., Thöni, Ch. (2004), "Trust, Voluntary Cooperation, and Socio-Economic Background: Survey and experimental evidence", Journal of Economic Behavior & Organization, No. 55, pp. 505–531.
16. Galford, R., Drapeau, A. S. (2002), The Trusted Leader. Bringing Out the Best in Your People and Your Company, Free Press, New York.
17. Gibb, J. R. (1991), Trust. A New Vision of Human Relationships for Business, Family and Personal Living, North Hollywood, CA, Newcastle Publishing Company.
18. Glaeser, E. L., Laibson, D. I., Scheinkman, J. A., Soutter C. L. (2000), "Measuring Trust", Quarterly Journal of Economics, Vol. 115 No. 3, pp. 811–846.
19. Hosmer, L. T. (1995), "Trust: the connecting link between organizational theory and philosophical ethics", Academy of Management Review, Vol. 20 No. 2, pp. 379-404.
20. Humphrey, J., Schmitz, H. (1998), Trust and inter-firm relations in developing and transition economies, "Journal of Development Studies", Vol. 34 No. 4, pp. 32-62.
21. Johnson, D.W., Johnson, R.T. (1995), "Social interdependence, cooperative learning in education", Bunker B.B., Rubin J.Z. (Eds.), Conflict, cooperation and justice, Jossey-Bass, San Francisco, pp. 205-257.
22. Jones, G. R., George, J. M., (1998), "The experience and evolution of trust: implications or cooperation and teamwork", Academy of Management Review, Vol. 23 No. 3, pp. 531-546.

23. Jones, K., Leonard, L. N. K. (2008), "Trust in Consumer-to-Consumer Electronic Commerce", Information & Management, Vol. 45 No. 2, pp. 88–95.
24. Kanawattanachai, P., Yoo, Y. (2002), "Dynamics of Trust in Virtual Teams", Journal of Strategic Information Systems, Vol. 11 No. 3/4, pp. 187–213.
25. Karsgaard, M.A., Schweiger, D.M., Sapienza, H.J. (1995), "Building commitment, attachment, and trust in strategic decision-making teams: the role of procedural justice", Academy of Management Journal, Vol. 38 No. 1, pp. 60-85.
26. Lewicki, R.J., Bunker, B.B. (1996), "Developing and maintaining trust in work relationships", Kramer R. M., Tyler T. R. (Eds.), Trust in Organizations: frontiers of Theory and Research, Thousand Oaks, CA: Sage, pp. 115-139.
27. Nelson, K. M., Cooprider, J. G. (1996), "The contribution of shared knowledge to IS group performance", MIS Quarterly, Vol. 20 No. 4, pp. 409-433.
28. Paliszkiewicz, J. O. (2007), Zarządzanie wiedzą w małych i średnich przedsiębiorstwach – koncepcja oceny i modele, Wydawnictwo SGGW, Warsaw
29. Ryan, K., Oestreich, D. K. (1998), Driving fear out of the workplace: creating the high-trust, high-performance organization, Jossey-Bass, San Francisco.
30. Sabherwal, R., (1999), "The role of trust in outsourced IS development projects", Communications of the ACM, Vol. 42 No. 2, p. 80.
31. Seppänen, R., Blomqvist, K., Sundqvist, S. (2007), "Measuring Inter-Organizational Trust: A critical review of the empirical research in 1990–2003", Industrial Marketing Management, No. 36, pp. 249–265.
32. Shapiro, S. P. (1987), "The social control of impersonal trust", American Journal of Sociology, Vol. 93 No. 3, pp. 623-658.
33. Shockley-Zalabak, P. S., Morreale, S. P., Hackman, M. Z. (2010), Building the High-Trust Organization, Jossey-Bass.
34. Sitkin, S. B., Roth, N. L., (1993), "Explaining the limited effectiveness of legalistic "remedies" for trust / distrust", Organization Science, No. 4, pp. 367-392.
35. Solomon, R.C., Flores, F., (2001), Building Trust in Business, Politics, Relationships, and Life, Oxford University Press, New York.
36. Sprenger, R. K., (2009), Zaufanie #1, MT Biznes, Warsaw.
37. Whitener, E. M., Brodt, S. E., Werner J. M., (1998), "Managers as Initiators of Trust: An Exchange Relationship Framework For Understanding Managerial Trustworthy Behavior", Academy of Management Review, Vol. 23, No. 3, pp. 513-530.
38. Zand, D. E. (1972), "Trust and managerial problem solving", Administrative Science Quarterly, Vol. 17 No. 2, pp. 229-239.
39. Zand, D. E. (1997), The leadership triad, knowledge, trust and power, New York, Oxford University Press.
40. Zucker, L. G. (1986), "Production of trust: institutional sources of economic structure 1840-1920", Research in Organizational Behavior, Vol. 8, pp. 53-111.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

TO DEVELOPE TAIWAN TOURISM DEVELOPMENT STRATEGIES BASED ON THE TRAVEL EXPERIENCE IN THAILAND

Tzong-Ru (Jiun-Shen) Lee*, National Chung Hsing University, Taiwan
Email address:trlee@dragon.nchu.edu.tw

Hui-Chu Tung, National Chung Hsing University, Taiwan
Email address:icedhj@gmail.com

Cheng-Chun Hsieh, National Chung Hsing University, Taiwan
Email address:g101044001@mail.nchu.edu.tw
***Corresponding author**

ABSTRACT

The purpose of this research is to propose tourism development strategies in Taiwan based on author's travel experience in Thailand for past 10 years. Back in these years, one of the authors traveled from Taiwan to Thailand for more than 15 times, mainly in Bangkok and Chiang-Mai. The main task of these travels is to offer lectures in Kasetsart University and Chiang-Mai University. After lectures, the faculties in these two universities usually took the author to visit local spots to introduce the culture of Thailand. Based on the author's observation, tourists attracted by Thailand are because of the following reasons: first, Thailand's government put lots of effort in tourism. Second, People in Thailand are nice and friendly to new comers. Third, the nature environment is being preserved well, and last, the local culture with religion attracts people to visit. Later on, we propose several tourism development strategies for Taiwan.

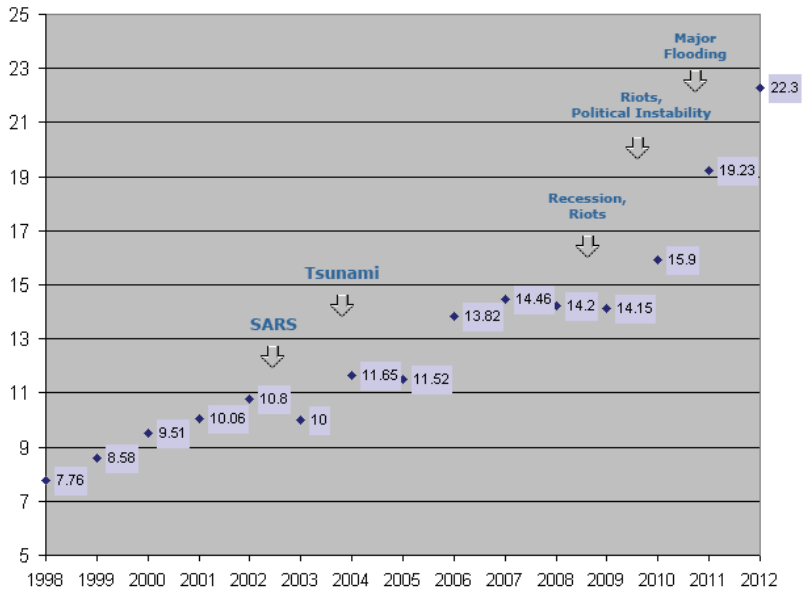
Keywords: travel, tourism, strategy formulation, Taiwan, Thailand

WHY DOES THAILAND DEVELOP TOURISM

In a time that the technology is improved and transportation well-developed, the global village is not a new concept anymore. From October to February, many residents who lived in the Northern Hemisphere will go to low-altitude tropical countries to stay away from freezing weather. As for the visitors visiting these countries, most of them will choose Thailand compare to other Southeast Asian countries to stay. This is why we came up with the motivation to research this issue.

According to the introduction of Thailand from the Thailand tourism bureau, Thailand used to be called Siam. Thailand's land area is about 5 million square kilometers, with around 69 million people. It's located in the central part of Indochina Peninsula between China and India. Most people in this country worship Buddhism and this country always has been the gathering place of religions, cultures, and many races in the Southeast Asian, which brought up Thailand's special culture and the best attraction to foreign tourists.

Lai (2006) pointed out that since the Vietnam War in 1960s, many American soldiers spent their holidays in Thailand increasing foreign exchange earnings and also improved the development of Thailand's architecture and facilities. Thailand's politics and economy didn't go as smoothly as always, though. Chen (2010) said that the financial crisis in 1997 impacted the environment of economy in Thailand heavily. But government combined the resources of private and public bureaus efficiently. It soon leaded Thailand's tourism out of the shadow of financial crisis by holding large international marketing activity "Amazing Thailand", plus spreading medical tourism and starting to use new airports. The data provided from the Office of Tourism Development (2013) displayed that although the political was unstable in 2009 and 2010, the financial bounce back and the flooding in middle Thailand in 2011, causing the number of tourists decrease, Thailand reaches its highest point of arrivals in the fourth season of 2012 which is 6.33 million, which makes the highest record in the last 15 years.



Source: www.thaiwebsites.com/tourism.asp, accessed on 2013/3/1

Figure 1 Yearly Tourist Arrivals to Thailand 1998-2012

Summing the above contents, the reason why Thailand develops tourism is not only that Thailand is the gathering place of politics and economy among the near Southeast Asian countries, but also the solution to deal with the impact of Vietnam War and financial crisis, which also speeded up the government's awareness and promotion to tourism. This research note is mainly to discover why Thailand's tourism is attractive and what Taiwan can learn from it. To answer this question, I'll use my own experiences back in these 10 years traveling to Thailand Bangkok and Chiang-Mai to discourse my observation and record them, in order to make the reference for this researches.

THE REASON WHY THAILAND'S TOURISM IS PROSPEROUS

Up 2013, many Southeast Asian countries such as Thailand, Singapore, and Malaysia all devote in promoting tourism. This research sorts out possible reasons why Thailand is able to attract foreign tourists after the long-term traveling experiences through Thailand, and divided them into four categories as Thailand's government, natural environment, the people in Thailand, and local culture, as follows:

(1) The Government of Thailand

- Thailand promotes the long-term travelers residency program to people who expected to reside in Thailand for up to a year, such as retirees or other specific groups.
- Thailand's government encourages tourism, and has real action, such as the huge international promoting activity called "Amazing Thailand".
- Thailand develops tourism earlier: From 1977, Thailand's government had started tourism development plan. The tourism has become the main income of Thailand's exchange, which makes Thailand's government more emphasize on developing tourism.

(2) Nature Environment

- Thailand has tropical weather with fruitful natural resources..
- Community—There are numerous rivers and to develop good water transportations. Local residents take bamboo raft as transportations.
- Geographic location—Thailand is located in the middle part of Indo-China Peninsula, the hub position of Southeast Asia. As the International Shipping Center, there is more than 80 airlines pass through. This made people around the world going to Thailand easily and conveniently.

Thailand gave a good foundation for tourism because they understood its superiority and made good use of resources.

(3) **People in Thailand**

- Most merchants in main tourism area can speak business English and European languages in order to make better communication with people from different countries.
- They use smile to interact with people, Thai is also called the country of smile because of that.

Thailand is a friendly country. With kindness greeting, Thailand makes tourists feel at home.

(4) **Local culture**

- Loyalty to Kings: Thailand has a unique and significant royal tradition, Thailand kings are esteemed by people and the king's posters and statues are visible everywhere.
- The Religion of Erawan Shrine: Buddhism is the national religion in Thailand, they believe Erawan Shrine is the god controlling prosperity in the human world and to praise harmonic.
- Provide Services of Releasing Stress, such as the Tai massage.
- Special Industries are Open. For example, Lady Boys and red-light districts.
- Special Spot: Merchants sale variable products in hot spots, such as Thailand night market, floating market, Thailand palace, and Erawan Shrine Altar.
- Special Show: Lady Boy show, crocodile show, elephant show and etc., become assigned package tours.
- Special Festival: Traditional Songkran Festival of April always attracts lots of tourists.

Summing the above possible reasons that Thailand can attract tourists to come to take a vacation, it can be classified into three parts: First, the local culture of Thailand is special. Second, travel plan is smooth and provide many shows. Third, government pays attention to tourisms. These factors make Thailand best choice of traveling in Southeast Asia.

SUGGESTION TO TOURISM RELATED INDUSTRIES IN TAIWAN

Taiwan used to emphasize on manufacturing and export processing. Taiwan government should change its focus on economy development by tourism or cultural and creative industries' diverse development to advance the economics. As for that, we listed the solutions Taiwan can

refer to do by the former stated observation how Thailand attracts tourists as follows:

(1) For Government of Taiwan

- As for the role the government should play, it can compare the visa passing solution in Thailand to provide faster visa and passing to attract tourists to have long-stay in Taiwan.
- Different form Thailand, Taiwan is located in the hub position of East Asia, the numbers of flights are considerably large every day. Taiwan should construct more high quality flying environment.

(2) For Nature Environment

- Climate— Taiwan has subtropical weather. The climate is mild and suitable for tourists all year.
- Geographic Location—Taiwan is an island country surrounded by sea. The topography of Taiwan is various and cause high biological diversities.
- Taiwan's land area is just 36,000 square kilometers. No matter you want to go to high mountains or the blue sea, you can arrive there within two hours. Compare with other countries, traveling in Taiwan to visit mountain or sea is more convenient.

Although the city of Taiwan has well developed traffic infrastructure; major attractions are located in remote regions. Hence, tourism industry in Taiwan can be further developed by having different types of tour packages around this island. In terms of Marketing, what Taiwan can do is that when tourists arrive at an attraction, they can check into places on a register and get one point. After collecting 10 points, they can get a souvenir for free.

(3) For People in Taiwan

- Taiwan should find its own soft power to find special point of Taiwan. Such as Taiwanese's enthusiastic which is always arouse foreigner's surprising.
- Taiwanese has good reputation in terms of friendly and mercy internationally. When serious disasters happen around the world, Taiwan's assistance always come thick and fast.
- Tourists from Europe and US prefer tidy and clean place to consume, Taiwan should enforce the train of cleaners to keep a nice homeland impression.

The recommended method of our research:

The government can provide different kinds of subsidies and educational training to

improve the quality of service of stores. The government can also train more young people to serve tourists in different languages. By doing this, we can show Taiwanese' hospitality.

(4) For Local Culture

- Taiwan has been dominated by Holland, Spain and Japan in sequence, so we fuse characteristics of multiple cultures.
- Performing Arts: Almost all of the adjacent countries have their unique performing shows; Taiwan needs to strengthen own traditional performing arts to make them become our traveling highlights. The traditional performing arts include aborigines' singing and dancing or "Din Tao", etc. By doing so, Taiwan's performances will gradually be on the world's stage.
- Snacks Culture: Snacks possess special cultural meanings. Taiwanese' will prepare occasional snacks for special festivals, such as sticky rice balls for Lantern Festival and zongzi for Dragon Boat Festival, etc. These phenomena show the simple life style of civilians.
- Night Market Culture: Night markets not only provide cheap but high-quality snacks, such as oyster omelets and steamed dumplings, but also provide different kinds of scarce products. Night markets are the place that you cannot miss while visiting Taiwan.
- Traditional Festivals: Taiwan can expand the scale when holding Taiwan's special festivals, such as Lantern Festival. For example, to invite travelers all around the world join with us to celebrate the festivals, making these festivals become international activities.

CONCLUSIONS

This research views the process of Thailand developing its tourism, and discovers that Thailand really makes the resources of the country into usable resources. Thailand's government noticed the strong potential of tourism a long time ago, which becomes the strategic motivation of Thailand to fulfill its national goal. Besides, because tourism is a service industry that involves with many other things, and to develop service industry is helpful of raising the efficiency of other industries, so tourism is an ideal leading industry. Based on the external effects that developing tourism can bring up, it relies on government to lead the process as the leading role. And regarding from Thailand's experiences, tourism is helpful to mediate the stress from financial impact.

The reason of Thailand's prosperous tourism industry is that the government can use their

resources correctly to show Thailand's distinctive fascination. Taiwan is a country with multi-culture; Taiwan composite environment is as good as Thailand. If Taiwan can find out Taiwan's core value by comparing transnational, be clear of Taiwan's position, grasp the advantage of the industry (For example, the quality of Taiwan's ICT industry is famous around the world, so we can apply it to the tourism industry in many ways.), show the beauty of Taiwan to the world, the tourists will naturally come to Taiwan in an endless stream.

REFERENCES

1. Jenn-Jaw Soong, 1996. Southeast Asia's political development, Wu-Nan Book Co., Ltd.
2. Ministry of Foreign Affairs (Taiwan): http://www.mofa.gov.tw/Official/Home/RelatedLink/?opno=a4c75b5f-a306-42f8-8321-fd25cdea5e4e, accessed on 2013/3/31
3. Ming-Tai Lai, 2006. The Marketing of Nations and International Competitiveness: A Study of Tourism in Thailand, Tamkang University, Taiwan
4. Shang-Mao Chen, 2010. The Political Economy of Tourism in Thailand, Taiwan Journal of Southeast Asian Studies, Vol.7, No.1, p. 41-74.
5. Tourism Authority of Thailand : http://www.tattpe.org.tw/KnowThailand/know_tai_intro.aspx, accessed on 2013/2/1
6. The Office of Tourism Development (Thailand) : http://www.thaiwebsites.com/tourism.asp, accessed on 2013/2/1

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

CONCEPTUAL FRAMEWORK FOR DECISION SUPPORT SYSTEM OF THAI FRUITS

Sawang Panjun, Department of Industrial Engineering, Faculty of Engineering, Kasetsart University, Thailand, sawang26@yahoo.com

Punnamee Sachakamol, Department of Industrial Engineering, Faculty of Engineering, Kasetsart University, Thailand, fengpmsa@ku.ac.th

ABSTRACT

This article aims to propose a conceptual framework for Decision Support System (DSS) of Thai fruit's activities in Thailand. This research presents a new model with the application of Cold Chain Management, which will be integrated to the Quality Control (QC) of the fruits, harvest to extraction, storage and transportation process, and including the export of fruits to a customer in a foreign country. The framework also focuses on forecasting method to predict the damage caused by the choice of each activity in the process. The simulation analysis on logistic model will then be designed to determine the possibilities of outcome from various parameters, for example, farmers, exporters, appropriate age to harvest, mode of transportation of clients in each country, transportation costs, fines, and the rate of loss that is expected to occur. The Decision Support System will be used to aid the farmers on the optimal reasonable sale price, provide the exporters with the information on how to manage the fruits properly during shortages or harvest season. So that the fruits are available to the needs of customers in every moment, accessible raw materials, development of domestic production, higher quality export and minimum waste.

Keyword : Conceptual Framework, Decision Support System, Thai Fruit, Cold Chain

INTRODUCTION

Currently, Thailand is one of the most success fresh fruits export country to the world. In the year 2012 Thailand was export fresh fruits to overseas about 1,038 Million Tons with value 19,327 Million Thai Baht. When compare the fiscal year 2011, the value has increasing at 36.78% (Office of Agricultural Economics, 2013). Where, the important business partners as importer are China, Japan, United State of America, Malaysia, Indonesia, South Korea, United Kingdom, Vietnam, Australia, and Cambodia accordingly. Due to those importers are able to grow the plant but it does not fulfill internal consumption and cost of planting is tend to increase for each fiscal year. These reasons made the referred countries have to import fresh fruits from Thailand and Other export countries in a large volume. However the import rules of each county have a lot of limitation, some countries have strong focus and limit the concentration of retained pesticides, plant pathology, insects. It is for concerning about consumer sanitation as crucial issues. Many countries have the regulation to eliminate the oriental fruit flies by steaming prior to import to the country.

At present, fruits export industries are still have risks from raw materials quality which delivered from Thai farmer at high side. The quality of fruits is mainly focus on fresh, residual toxin. During the crop season, a bulk of fruits come out this made producers or fruits conversion factory have to invest a lot of cost to purchase and store raw materials. This leads to increasing of material storage cost. On the other hands, the study does not yet research for a proper packaging, methods of storage, and also the right data communication between purchaser, 3rd party logistic and buyer. From the problems, it was made raw materials and fruits products decay during transportation. Due to most of the products are easy to decay, having short storage time, and damaged from improper products arrangement especially for a long delivery time. Those factors made price per unit cost increasing significantly.

From above problem background, it is initiating the concepts for decision support system for Thai fruits processing from production till export information technology management. The information will collect the data for fruits harvest, separation, storage, transportation, and export. The information system is also including lost predictive system from chain activities and quality simulation model for each step of fruits processing through end user hand over. According to this system, it will connect activity and data from farms, factories, and final customers effectively. The system will develop and improve business process together with machine that involve in harvest process, transportation, separation, storage, accumulative, collection, production, filling, and distribution. Main subject of the model will tend to; minimize lost, waste, harvest time and amount of fruits at the same area; maximize selling price; generating an effective management system. So, making of decision support system for Thai fruits processing for export is important for total chain operation to. To increase planning ability, support, management control, packaging, storage, logistic, and distribution with effectively and productively, reduce lost and cost reduction, also increase chance of market share and continual market expanding for Thai fruits trading value.

DECISION SUPPORT SYSTEM for THAI FRUITS

Decision Support System (DSS) is a computerize system that enhance and made a bulk of data comes easy in term of data collecting and data analyzing for users. To solve the complicated problems or planning, DSS is able to increase level of a persons whose make the decision. it leads to time reduction and reduce human resources during analyzing period. (Jones et al., 1998) of those advance of information technology at current situation made farmers and exporters applied the information technology to use in their business (Kropff et al., 1998).

Major components that use for decision support are data system management, data analysis system which interaction between interface and users. To design for each module are differences depending upon objective of system target users. In the past time, analysis system and system processing of decision support system done by modeling and simulation. It was developed and used widely to promote decision support system for Thai fruit. Decision support system program was integrated with products quality model, data base, and application program together (IBSNAT, 1989). Decision support system for Thai fruits users are able to call for fruits genetic, soil preparation, growing, nursing, and harvest. The system is also able to retrieve for fruits separation methods, buyers, and market. These data will use to simulate level of products quality, products prices, expire date and shelf life; all together

with guide line for transport both domestic route and international route. Software will demonstrate these data in format of data table and comparable graph to let users decide on the proper track and time.

DECISION SUPPORT SYSTEM DEVELOPMENT

From literature review, it was found that the development of decision support system for use in agricultural data management from products care, quality inspection, proper transportation, and proper sale direction for export company and domestic farmers. By this concept the system will estimate cost, processing time, and rate of income from each choice. The system is also including for trace back action for goods and raw materials which involve in process. Finally, it is made farmers, exporters, importers, and consumers having trust in quality of products. For both supplier and customer to be consider for making business in further. This system will estimate quality of fruits after harvest. The quality of fruits was determined by day counting, and temperature measurement after harvest. Both parameter are inverse variation to products quality. Decision support system structure is able to describing as figure below.

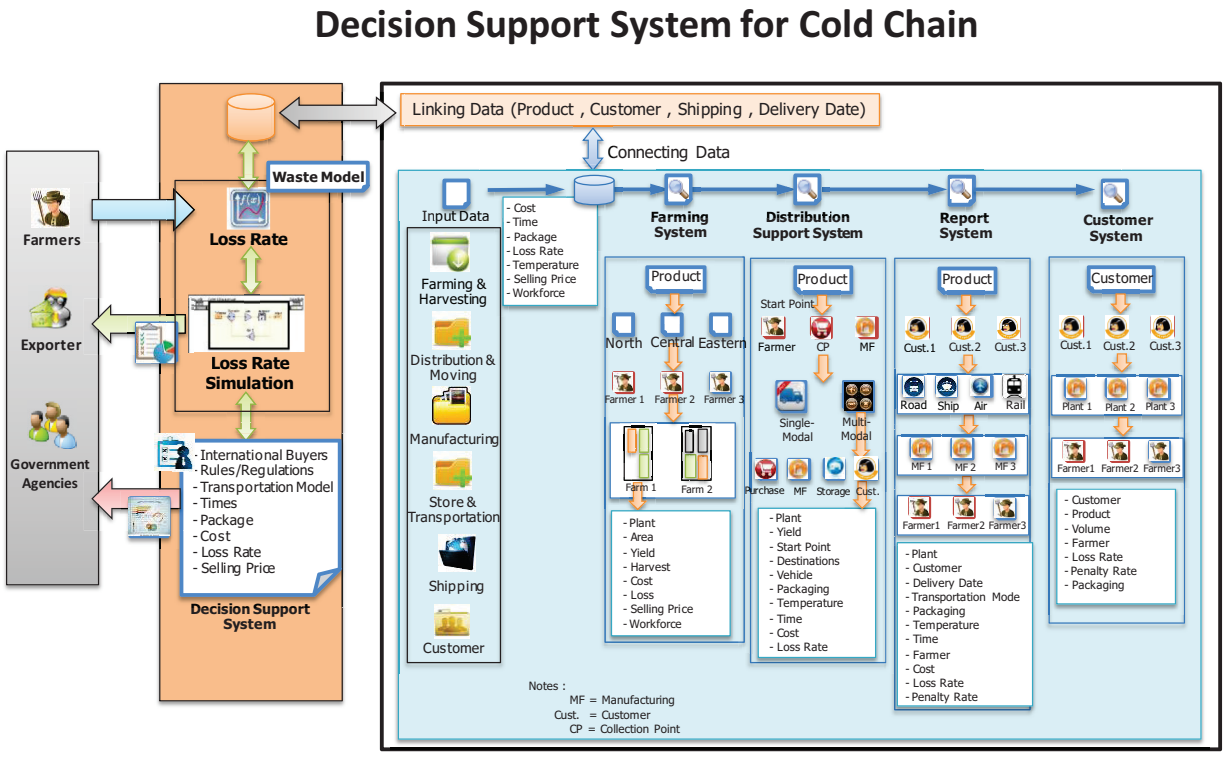


Figure 1: Structure of Decision Support System and quality evaluation system

According to Figure 1, the structure of decision support system for Thai fruits is consisting of many components which linked to relational data base. Refer to relational data base; it is collect detail for each parameter. Where, it is able to support for important data transfer to processing in quality model and lost model for each processing steps. Relational data has connected by dedicated data linking system to support decision support system for farmers,

exporters, importers, consumers, and government sectors. The developed decision support system for Thai fruits can describe in Figure 2.

Products Harvest System is the systems that operates for data collecting and propose the solution for agricultural management. It is for maximize quality and price based on harvest time, price of fruits, weather conditions, labor conditions, cost, transportation cost form farm to storage. These data will be collect by farmer interviewing and Thai fruits related business owner in each area of domestic farm.

Products Separation Data System is the system that collecting data and proposes for solutions of selective the system for quality, size, surface appearance, and bruised physical property. These data are effect directly to price level after fruits harvest.

Products Logistic System is the system that analyses for the factors which relevant to transportation cost for both in land and overseas. In general, cost of logistic is very important for business operation. It is effect directly to total cost of goods. Cost of logistic, the business owner must concerns for volume of goods which ship to final destination, loading time, expense, lost due to transportation. In some time, blank container has involved, so goods distribution center must be consider. Distribution centre is able to reduce cost by blank container. To collect the fruits from farm until ware house have enough fruits to fill in container.

Products filling system is the system which consider on the factors that related to products quality level. Due to the appearance of proper packaging for products and methods of transportation, it is made famers and buyers able to keep products on shelf longer than the products that use improper packaging. On the other hand a good packaging is able to reduce products damage due to transportation. Good packaging also shown a well appearance which gives a spiritual value, which provide value added for products.

Products quality controls system is the system that provides caring and nursing methods for fruit trees before and after harvest for fruits. A perfect body fruit trees will gives high products quality and quantity. It is lead to selling in high price due to a high quality of products. To control a proper level of water, fertilizer, plastic cover on fruits, and awareness of insects and disease on fruit trees are lead to a good products quality, which having a proper size to export. This system makes low loss and high products price. It is also a provide guide line to manage products during packaging in factory and transport to buyers both domestic and overseas.

Products auditing system is the system that use for evaluate quality of products after passed the conversion. Conversion means value added products and non-value added products, it was made change in products quality. This header is able to test experiment from real fruits, this experiment will start from fruits harvest, separation, transport to export factory, processing, packing, handling, and transportation to end users.

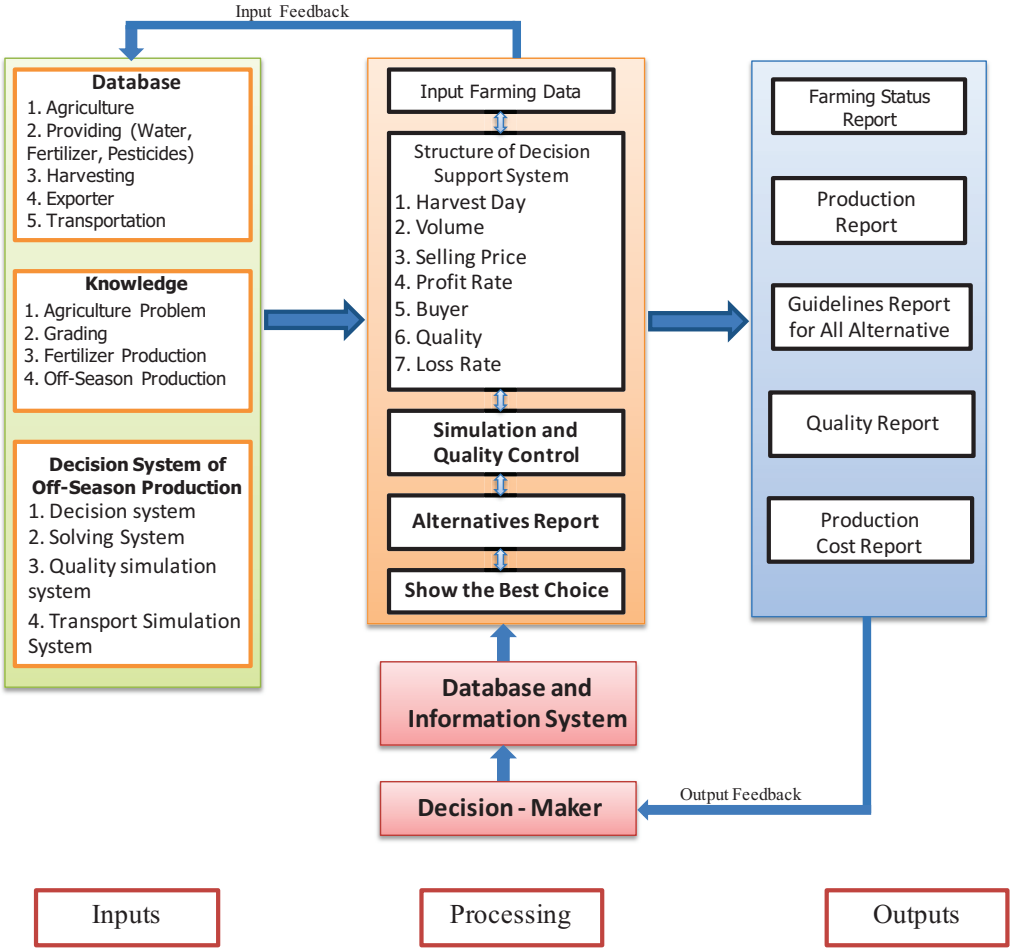


Figure 2: Decision Support System Structure and quality audit system

IMPLICATIONS AND LIMITATION

Implication

Refer to research, it was found that the factors that important on success of famers, exporter, and consumers decision making are alternative high probability data for decision making and also include up to date technology for developing data management. This system will provide information from information media for alternative ways of decision making, which included guide line of effective management and products and raw materials tracing by business operators. These factors are effect directly to business operation results, where some will reduce operation time and data retrieving in company. By those applied system to the company, it was made business owner whose produce fruit products for trade in domestic market and overseas market able to increase in competitiveness in market. However decision support system for Thai fruits is the system that proper for highly care fruits which having short shelf life. Also storage temperature is effect directly to quality of fruits especially for mango, mangosteen, longan, durian, rambutan, and pineapple. To increase level of competitiveness, business operator will look through lost, quality level, cost, revenue, regulation, and operating time. Those data is a must prepared from planting, nursing, havert,

to transportation to consumers. Where the data preparation and latest information technology are applied for data collection and presentation.

Limitation

It was found that, development of decision support system preparation for Thai fruit products some of users need to input and correction at real time but at current system. It is lead to user have to operating in a long time and use a lot of resources to complete decision support system effectively.

CONCLUSION AND DISCUSSION

Conclusion

Decision support system made business operators act their business effectively. It was prepared to serve business operators to work with high efficiency. On the other point of view, decision support system is also support business operator and prepares a choice of information for decision making. Decision support system is also stimulating staff in company to share their comment. Side benefits, decision support system is arrange and mange level of important issues from high important to less important and back up conference results for proper time in succession. On the other hand, decision support system is al so increase ability, efficiency, and productivity for the firm. Applying of decision support system is made the company save the time for decision making and reduce number of meeting with accuracy data and high reliability data.

Discussion

Way to develop decision support system in future, It will integrate cool chain management system from harvest, separation, storage, and logistic. It will concern for handling and storage improvement at proper temperature. Major reasons for decision support system improvement are extend shelf life, maintain products quality, and increase market share in overseas. Currently, some of fruits are export by air freight, which having a high transportation cost. The future of decision support system devilment will support for sea freight for Thai fruits which will lowering cost of transportation and make widely distribution to other countries.

REFERENCES

1. Abbott, J.A. (1999). *Quality measurements of fruits and vegetables. Postharvest Biol. Technol.* 15, 207–225.
2. Fox, J., Kantar, R., Yarnasarn, S., Ekasingh M. and Jones, R. (1994). *Farmer Decision Making and Spatial Variable in Northern Thailand*. Environmental Management. 18 (2): 391-399.
3. Interntional Benchmark Sites Network for Agrotechnology Transfer (IBSNAT). (1998). *Decision Support System for Agrotechnology Transfer Version 2.1 (DSSAT v.2.1)*. Department of Agronomy and Soil Science, College of Tropical Agriculture and Human Resource, University of Hawaii, Honolulu, Hawaii, USA.

4. Jitareerat, P., Uthairatanakij A., Wongs-Aree, C. and Wongshere, T. (2552). *Effect of Gamma Irradiation on Quality of Mango Fruit*. Postharvest Technology Innovation Center, Chiang Mai University, Thailand.
5. Jones, P.D., K.R. Briffa, T.P. Barnett and S.F.B. Tett. (1998). *High-resolution palaeoclimatic records for the last millennium: interpretation, integration and comparison with General Circulation Model control-run* temperatures. The Holocene. 8: 455–471.
6. Ketsa, S. (2528). *Physiology and Postharvest Technology of* Fruits *and Vegetable Carving*. Office of Extension and Training, Kasetsart University, Kamphaeng Saen Campus.
7. Kropff MJ, van Laar HH, Matthews RB. (1994). *ORYZA-1: an eco-physiological model for irrigated rice production*. Los BanÄ os, Philippines: International Rice Research Institute.
8. Molto, E., Selfa, E., Pons, R., Fornes, I., and Juste, F. (1998). *A firmness sensor for quality estimation of individual fruits*. *Acta Hort*. 421, 65–72.
9. Nickerson, D. (1964). *Color measurement and its application to agricultural products*. USDA Misc. Publication No. 580, Washington, DC.
10. Office of Agricultural Economics. (2013). *Basics Information of Agricultural Economics 2012*. Information Center, Department of Agriculture Extension, Thailand.
11. Sombatpraiwan, S., Tipyavimol, T. and Treeamnuk, L. (2555). *A Study on Ripening Delay of Mangifera indica Linn. cv. Nam Dork Mai*. The 13th Annual Conference of thai society of Agricultural Engineering, International Conference on Agricultural Engineering, Chiang Mai, Thailand.
12. Uthaibutra, J., Saengnil, K., Whangchai K., etc. (2555). *Effect of Storage Temperature on Quality Change of 'Mahajanaka' Mango Fruits*. Science and Technology Research Institute, Chiang Mai University, Thailand.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

FORMATION OF BRAND EVIDENCE IN RETAIL BANKS

Chiachi Tsan, Dept. of Finance, Lunghwa University of Science and Technology, Taiwan
Email: tsan_eric@gm.lhu.edu.tw

Hsin-Fu Chen, Dept. of Finance, Lunghwa University of Science and Technology, Taiwan
Email: hsinfu@mail.lhu.edu.tw

ABSTRACT

Purpose: *The retail bankung industry has become increasingly competitive in Taiwan after the government's policy of deregulation and internationalization. Banks not only have to satisfy customers but also have to meet customers' needs and the changing preferences more effectively and effectively than their counterparts in order to maintain long-term competitive advantage. Building strong brand evidence in order to gain customers' attention has become one of the key issues in the industry. Nevertheless, relevant literature on the topic in the arena of retail banking industry, which plays an important part in the economy in Taiwan, is sparse. Therefore, the main purpose of this study is to explore the dimensions of brand evidence in the context of retail banking industry in Taiwan.*

Design/methodology/approach: *The study is conducted from the customers' perspective about how they perceive brand evidence in retail banks. The methodology employed is a combination of both qualitative and quantative methods including in-depth interview, focus group interview and factor analysis.*

Findings: *A questionnaire was established based on the result. After expert opinions and pretests, 200 questionaires were then distributed. The collected data were analyzed via factor analysis. The empirical results demonstrated that brand evidence was composed of five factors including employee service, core service, self-image congruence, brand name, and price.*

Originality/value: *In the practical aspect, the study presents the dimensions of customer perceive value and thus provide directions for retail bank parctitioners to enhance the customer perceived value. In the theoretical aspect, the result helps to establish a foundation for future development of a customer perceived value measurement scale specifically suitable for the retail banking industry in other contexts. It can also provide a theoretical base for further investigation on the relationship amongst value and other constructs.*

INTRODUCTION

The banking industry was well protected by the government over the past decades, especially in developing countries. Under the government's monopolistic protection, the government-controlled banks dominated the domestic market. Until the wake of the new centry, the banking industry has experienced major deregulation reforms to remove entry barriers for bank establishment worldwide and introduce more competition. Under such operation environment, banking industry has become increasingly competitive and practitioners not only have to satisfy customers, but also to meet their needs and changing preferences to maintain competitive advantage.

Nowadays, brands play an integral part in strengthening competitive advantage and they are increasingly valuable assets and resources of differentiation (Lim and O'Cass, 2001). A brand acts as a mechanism in engaging both purchaser and seller in a long run customer-brand relationship (Davis, 2000). To the customer, a brand identifies the attribute of the product, which in turn assigns legal responsibility to the product maker, and it provides a promise or bond with the producer (Lassar, *et al*., 1995). Brand also reduces search costs of consumers, perceived risk, and signal the quality of the product (Biswas, 1992; Shimp, 1993; Erdem, 1998; and Janiszewski and van Osselaer, 2000). Therefore, the brand becomes the advantages to the consumer in term of both economic and symbolic value. To the firm, branding plays a unique role because stronger brands not only boost differentiation among rivals, but also strengthen trust, facilitate visualization, reduce research costs, minimize perceived risks, and represent high quality from a consumer's point of view (Hosany *et al.,* 2006 and Kim *et a.,l* 2008). In addition, the advantages of strong brands are not only in the marketing of physical goods, but are also in highly prevalent where services are concerned.

Today, a number of theoretical frameworks have been proposed in an effort to understand how consumers think about, and respond to brands (Keller, 1998; and de Chernatony and Dall'Olmo Riley, 1998). The marketing researches also pay a lots attentions on how buyers verdicts on service brands (Grace and O'Cass, 2005). Whereas, Keller (2002) laid out a series of steps for building brand equity, and suggesting that consumer brand relationship is the final step. The consume-brand relationship depends largely on the successful establishment of the brand meanings. These meanings can be formed directly from a consumer's experience.

Although, there are available marketing researches on how consumer perceives service brand, these researches were conducted in developed countries (Grace and O'Cass, 2005; Şahin *et al.,* 2011; and Papista and Dimitriadis, 2012), there is little research on service brand in

Asian countries. This paper aims to investigate brand evidence of services in banking industry in Taiwan, and how the construct is formulated.

LITERATURE REVIEW

The service brand

Brand refers to "a name, term, sign, symbol, design, or combination of them which is intended to identify the goods and services of one seller or group of sellers and to differentiate them from those of competitors" (Kotler, 2006). A brand acts as a mechanism in engaging both consumer and seller in a long-term consumer-brand relationship (Davis, 2000).

In the service context, the service brand comprises multiple factors including customer perceptions of service quality, the people standing behind the service, and the quality of the supplier/customer relationship (Berry, 2000; Dall'Olmo Riley and de Chernatony, 2000). It is shown that in packaged goods, the physical goods is the primary representation of brand. However, with services, the company is the primary brand (Berry, 2000). This is argued in the literature that service is characterized by:

- Intangibility: the value delivered by the service provider is much less tangible;
- Heterogeneity: intensive interaction between the customer and the service provider makes each service encounter a heterogeneous experience;
- Inseparability: the production and consumption of service occur simultaneously and inseparably; and
- Perishability: services cannot be stocked and perish immediately after consumption finishes (Zeithaml *et al*., 1985; Bowen, 1990; Dall'Olmo Riley and de Chernatory, 2000; Lovelock and Gummesson, 2004; and Laroche, 2007).

Brand experience

Since service contains more intangible element than the physical goods counterpart, customers might search for more tangible cues inorder to evaluate the purchase. Recent research has focused on utilitarian product attributes and category experiences which provided by brands' consumption. Brakus *et al*., (2009) defined brand experience as sensations, feelings, cognitions, and behavioral responses evoked by brand-related stimuli that are part of a brand's design and identity, packaging, communications, and environments.

According to Alloza (2008), brand experience is a conception of the perception of the consumers, at every moment of contact they have with the brand. This includes the brand images projected in advertising, during the first personal contact, or the level of quality concerning the personal treatment they receive. Ambler *et al*., (2002) reported that brand experience is created when customers use the brand; talk to others about the brand; seek out brand information, promotions, and events, and so on.

Therefore, brand marketers must bond with consumers by staging holistic brand experiences (e.g., Schmitt 1999; Pine and Gilmore, 1999). The marketing strategies associated with the brand, effects the consumers "mind-set" with respect to the brandwhat they know and feel about the brand. The customer mind-set everything which exists in the customers' minds with respect to a brand (e.g. thoughts, feelings, experiences, images, perceptions, beliefs, attitudes and so on) that is defined brand equity (Ambler, 2000). When consumers look for, shop for, and consume the brands, they are exposed to utilitarian product attributes.

Moreover, they are also exposed to various specific brand related stimuli, such as brand-identifying colors (Belizzi and Hite, 1992; Meyers-Levy and Peracchio, 1995; and Gorn *et al*., 1997), shapes, typefaces, background design elements (Mandel and Johnson, 2002), slogans, mascots, and brand characters (Keller, 1987; and Brakus *et al*., 2009). These brand-related stimuli are considered as part of a brand's design and identity (e.g., name, logo, signage), packaging, and marketing communications (e.g., advertisements, brochures, Web sites) and in environments in which the brand is marketed or sold (e.g., stores, events). These brand-related stimuli compose the major source of subjective, internal consumer responses, which is referred as "brand experience" (Brakus, *et al*., 2009). Hence, brand experience is defined as subjective, internal consumer responses (sensations feelings, and cognitions) and behavioral responses evoked by brand-related stimuli that are part of a brand's design and identity, packaging, communications and environments.

Brand evidence

Brand evidence is the set of service brand associations experienced by the consumer during the pre-purchase and consumption stage. In the pre-purchase stage, consumers can evaluate the evidence of the service brand throughout its more tangible (or known) attributes such as the brand name and price (Janiszewski and van Osselaer, 2000). It is supported that the brand name is more important when there is a lack of available information (as is often the case with services) as the brand name becoming a surrogate for missing attribute information (Degeratu *et al*., 2000). Beside the brand name, price is another attribute of the brand that can

often be assessed prior to consumption.

However, from the consumer's perspective, price is much more than just a monetary figure. It is the perception of what is given up or sacrificed to obtain a product or service (Zeithaml, 1988) and is more aptly referred to as ''perceived price''. Dodds *et al*. (1991) expand on this concept by revealing the notion of ''perceived value'' as ''a cognitive tradeoff between perceived quality and sacrifice''. In addition, perceived value has received considerable attention in the literature because of its influence on purchasing behavior of the consumer (Eastlick and Feinberg, 1999; Sweeney and Soutar, 2001).

Neverthe;ess, what is easily seen or known about the brand is just a part of what contributes to the consumer's overall response to the brand. For instance, the consumer's evaluation process continues during consumption. On a basic level, the service provided (core service) and the way in which the service is offered (via the behaviors of service providers) is evaluated. On a more abstract level, the feelings aroused while using the service and the extent to which the image of the service is matched with the consumer's own also influence their overall evaluation of the service brand.

At the basic level, the core service and employee service are closely related in that the core service refers to the processes by which the service is delivered whereas the employee service refers to the behaviors or performances of the employees in the delivery of the service (Johns, 1999). In terms of the core service, Danaher and Mattsson (1998) provide an example which can effect consumer evaluations that the relative degree and intensity of activities and interactions to waiting periods during the service delivery may impact on evaluations and the duration per se have an influence on rating outcomes.

At the abstract level, feelings play an important role in consumer decision-making. Babin and Babin (1999) argue that feelings have a profound effect on consumption experiences and consumer reactions. Jayanti (1995) supported that due to physical cues often being limited, the inclusion of feelings as a basis for service evaluation is warranted.

It is possible that affective responses towards service providers may explain incremental variance in service encounter evaluation compared to cold cognitions. Because most service encounters are typically characterized by lack of information, uncertainty and high perceived risk (Jayanti, 1995).

Moreover, Keller (1998) assumes that the personality and behavioral traits of both the product/service brand and the customer are reflected through the user's image, the usage situation and the brand's personality. User imagery indicates the perceptions' consumers hold of the type of person who uses the product or service (Keller, 1998). These attributes can be formed from the consumer's own experience of contact with brand purchasers or through the image portrayed via marketing communications. On the other hand, usage imagery describes the situational factors in which the brand is used, for example, time of day, month, year, location or type of activity. In summary, user and usage imagery reveal the stereotypical user of the product or service in the context within which it is used (Biel, 1993; Sirgy *et al*., 1997). This is the perceptions within these imageries that often guide the development of brand attributes (Plummer, 1984).

In summary, the brand experience and brand evidence of service brands represents much more than just the extrinsic cues (e.g., brand name, design, logo, communication, servicescape, and price). It also represents all of the brand dimensions of the service that affect the consumer's evaluation of the brand, for example, the core service provided, the behavior and appearance of employees. The degree to which the brand's personality matches that of the consumer and the feelings aroused during service usage all contribute to the consumer's perception of the service brand. These dimensions (both tangible and intangible) provide the body of brand evidence accessed by service consumers. Thus, brand evidence provides the foundation upon which consumer reacts to service brands.

From the above literature search, it is preliminarily deemed that brand evidence is made up of seven major components. They are brand name, price/value/money, servicescape, core service, employee service, feelings, and self-image congruence. Brand name was measured by two items proposed by Grace and O'Cass (2005). Employee service was measured by multiple item scales adapted from previous research (Cronin and Taylor, 1992). Core service was scaled by five items from Grace and O'Cass (2005). Price/value for money was measured by four items adapted from Sweeney and Soutar (2001). Self-image congruence was used three-item scale proposed by Sirgy *et al*. (1997). Feelings measurement was adapted through Jayanti (1995) by three indicators. The result is shown below in table 1. The result can further be used to develop a questionnaire to collect consumers' perception towards the brand evidence.

Table 1: Summary of brand evidence diemmnsions

Dimension	Measurements	Sources
Brand name	This brand is famous This brand carries a sense of trust	Grace and O'Cass (2005)
Price/value/money	This brand provides a good service for the price. This brand offers value for money Using this service brand is economical.	Sweeney and Soutar (2001)
Core service	The core service provided is desire. The core service provided is reliable. I can depend on this brand to provide good core service. This brand provides quality core service. The core service provided by the brand is superior.	Grace and O'Cass (2005)
Employee service	I receive prompt attention from the service employees. Employees of this service are always willing to help me. The employees of this service are never too busy to respond to my requests. I can trust the service employees I feel safe in my transactions with service employees. Employees of this service are friendly.	Cronin and Taylor (1992)
Feelings	I feel happy when using the service I feel confident when using the service I feel impressed when using the service.	Jayanti (1995)
Self-image	The image of brand name is consistent with my own self-image. Using the service of brand reflects my social status. Most customers of this brand are the same as my status.	Sirgy *et al.* (1997)

The above result is then used to formulate the questionnaire for data collection. To summarize the above mentioned, the question for this research is proposed as "What factors made up the brand evidence?" We explore this from the consumers' perspective and use the bank customers as an example.

METHODOLOGY

The research process of this study is composed of the setting the research objective, followed by relevant literature research and adopting relevant research methodology including questionnaire design, data collection methods and data analysis. The research findings, conclusions and recommendations will be presented at the end.

Quantitative research methods including factor analysis and multiple regression are utilized in the study. Questionnaires were used to collect data for further analysis. The questionnaire was formulated according to the perceptual measures identified within the literature and adapted accordingly, and opinions from interviewed practitioners and consumers to make sure the comprehensiveness of the study.

In order to avoid ambiguity of the wording in the questionnaire, a pretest was undertaken before the questionnaire was finalized. Question items which were vague and not easily understood were modified or deleted. A total of 20 participants were asked to rate the questionnaires in terms of format, the measurements of all constructs, the customers information. The participants indicated minor wording issues and recommended the format to be more user friendly. The sampling frame is people who lived in the northern Taiwan area and over 20 years old prior to the interview. The sample method is snowball sampling. Questionnaires were distributed to the qualified respondents via trained personnel. A brief training and introduction on the objectives of the study to the data collection personnel were made prior to the questionnaire distribution in order to increase the response rate and make the questionnaire collection process smooth.

According to Hair, Anderson, Tatham and Black (1998), the sample size is suggested at the level of 5 to 10 respondents for each variable if the data set is to be factor analyzed, and the total sample size is advised to exceed 100. In addition, Hair *et al.,* (1998) also propose that the sample size to over 150 in order to be appropriate to obtain feasible solution. The questionnaire items for factor analysis are 20 and considering the possibility of no response and invalid questionnaires, we decided to use the upper bound to determine the sample size that is 200. In order to avoid invalid questionnaires, 20 more samples are included. Therefore

the total questionnaires distributed were 220.

The questionnaires were delivered to customers using mall intercept approach in major business area in Taipei. The respondents were asked about their demographic information, including gender, age and occupation.

RESEARCH FINDINGS

The profile of respondents

There were 220 respondents took part in the survey. 200 questionnaires were considered valid. The proportion of male subjects was 47.2%, the proportion of female respondents was 53.8%. Respondents aged under 39 years old represent 69.6% of the sample. The majority of the respondents are people working in the service sector (40.3%).

Reliability

The reliability was first tested and Cronbach‘s alpha coefficient, an index to evaluate internal consistency, was calculated. Reliability analysis refers to the measurement of reliability is to measure the degree of consistency or stability. We used SPSS analysis software package to measure the value of Cronbach's alpha reliability of this questionnaire, It is suggested that the Alpha exceeds 0.7 threshold to be reliable, and lower than 0.3 indicating low reliability (Hair *et al.,* 1998). The Alpha coefficient in this study is 0.932, implying the high reliability of the questionnaire.

In order to understand the respondents’ perception towards the brand evidence of retail bank, we undertake factor analysis summarize the parsimonious factors derived from the perception variables. Factor analysis is a multivariate statistical technique with an analysis of interdependence methods. It is used to summarize the information contained in a large number of variables into smaller number of factors in order to simplify the data set (Hair, Bush, and Ortinau, 2003). Before conducting the factor analysis, it is advised to know whether the data collected is suitable for factor analysis. the Kaiser-Meyer-Olkin (KMO) was first estimated. According to Kasier (1974), if KMO is larger, it means there is more common factors among the variables and thus more suitable for factor analysis. If KMO is smaller than 0.5, it is not suitable for factor analysis. The KMO of the study is 0.929 indicating the data is appropriate to be factor analyzed. In addition, Bartlett’s test of sphericity, a statistical test for the presence of correlations among variables, is undertaken. The chi square is 2933.798

($p<0.001$), showing statistical significance. It again means that the data set is suitable for factor analysis.

Factor analysis

To concentrate the effect of variables in research dimensions, every research variables are conducted with factor analysis. The scales were submitted to exploratory factor analysis. Using the principal component method, varimax rotation, and under the criteria of factor loading larger than 0.4 and eigenvalue larger than 1, four factors are extracted. The total variance explained is 63.253%, an acceptable level in most social science studies. The result is presented in table 3.

Table 3: Result of factor analysis

Items	Employee service	Core service	Self-image	Name	Price
I can trust the employees of this bank	.831				
I feel safe in my transactions with bank's employees	.825				
Employees of this bank are friendly	.810				
When using the service of this bank I feel happy	.801				
When using the service of this bank I feel confident	.753				
When using the service of this bank I feel impressed	.731				
Employees of this bank are always willing to help me	.566	.426			
The core service provided by this bank is reliable		.830			
I can depend on this bank to provide good core service		.819			
This bank provides quality core service		.805			
The core service provided by this bank suits my desires		.732			
The core service provided by this bank is		.713			

Items	Employee service	Core service	Self-image	Name	Price
superior					
Using the service of this bank reflects my social status			.820		
The image of this bank is consistent with my own self-image			.811		
Most customers of this bank are the same as my status			.759		
The brand name of the bank carries a sense of trust				.802	
The brand name of the bank is famous		.411		.778	
Using this banking service is economical					.751
This bank provides a good service for the price					.732
This bank offers value for money					.641

Originally, all items are deemed from six sub-constructs of brand evidence including brand name, core service, employee service, feelings, self-image congruence, and price/value/money. However, the result showed that they were extracted in five factors including employee service, core service, self-image congruence, name, and price. The only difference is that the first factor "employee service" was comprised of employee service and feelings. Factor two is core service; factor three is self-image congruence, factor four is brand name, and the factor five is price.

Convergent validity

In order to understand whether the research contains acceptable level of validity, we use a question item "Overall, I have a positive attitude towards the brand of the bank I most bank with." as the dependent variable and the five extracted factors as the independent variables to run regression analysis. Using stepwise regression from SPSS, five models were identified and Adjusted R^2 for model 5 is 0.588 ($p<0.001$). The five models are listed as follows.

Model 1：$Q_{21}=0.376F_2+3.429$

Model 2：$Q_{21}=0.374F_2+0.337F_1+3.426$

Model 3：$Q_{21}=0.373F_2+0.335F_1+0.248F_3+3.428$

Model 4：$Q_{21}=0.371F_2+0.327F_1+0.246F_3+0.213F_4+3.422$

Model 5：$Q_{21}=0.370F_2+0.323F_1+0.242F_3+0.212F_4+0.221F_5+3.42$

Where Q_{21} represents"Overall, I have a positive attitude towards the brand of the bank I most bank with."

F_1：employee service
F_2：core service
F_3：self-image congruence
F_4：brand name
F_5：price

The results indicate that the model was statistically significant, and the overall positive attitude towards the brand can be explained by the five factors extracted. Thus it is considered that the study demonstrates convergent validity.

Predictive validity

Using "I am willing to continue to bank with my bank" as the dependent variable and the four extracted factors as the independent variable, we run regression analysis. By using stepwise regression from SPSS, four models were identified and Adjusted R^2 for model 5 is 0.487 ($p<0.001$). The five models are listed as follows.

Model 1：$Q_{22}=0.438\ F_3+2.891$
Model 2：$Q_{22}=0.438\ F_3+0.326F_1+2.891$
Model 3：$Q_{22}=0.437\ F_3+0.326F_1+0.228F_2+2.892$
Model 4：$Q_{22}=0.436\ F_3+0.325F_1+0.226F_2+0.145F_4+2.893$
Model 5：$Q_{22}=0.436F_3+0.325F_1+0.225F_2+0.142F_4+0.111F_5+2.891$

Where Q_{22}:"I am willing to continue to bank with my bank"

F_1：employee service
F_2：core service
F_3：self-image congruence
F_4：brand name
F_5：price

The results indicate that the model was statistically significant, and the five extracted factors can be used to predict the consumers' intention to continue their relationship with the bank. Consequently, the study demonstrates predictive validity.

DISCUSSION AND MANAGERIAL IMPLICATIONS

The result from factor analysis showed that brand evidence is made up of five factors termed employee service, core service, self-image congruence, name, and price. The factor employee service was composed by employee service and feelings. This can be explained that banking customers appreciate employee service of a service brand thank to the two elements. Partly, the process of customer evaluations about brand evidence prior to purchase will be based on how the service is provided and the interaction between service staffs and customers. These interactions with employees, or the moment of truth, create customers' feelings. Therefore, in this research employee service and feelings were categorized under the same factor and named employee service. This result is supported by recent researches that brand evidence is created by the perception of the consumers, at every moment of contact they have with personal contact (Alloza, 2008). This also resembles the finding that brand evidence results from feelings and behavioral responses evoked by brand-related stimuli that are part of a brand's communications and environments (Brakus *et al*., 2009). It further supports the findings from the current study.

I has been observed that human interaction in service delivery is an important determining factor of customer satisfaction (Reeves and Bednar, 1996). The consumers' preferences toward face-to-face interaction versus computer transactions vary depending on demographics of the consumer and characteristics of the financial products and services (Lee, 2002). In addition, there has been a rise in professional service providers who help customers with transactions that are perceived to be "too technical, too important, or too difficult to be made oneself" (Kimball *et al*., 1997). Therefore, a professional employee service still exists as an efficient instrument to foster financial service (Schlager *et al*., 2011). In order to approach a professional employee service, the employees must be satisfied with their job so they will deliver excellent service to make customer satisfaction. Previous research has confirmed that job satisfaction can have a significant impact on service quality and, ultimately, on customer perceptions of service quality (Snipes *et al*., 2005). It is proposed some managerial implications for service brand especially for financial service.

Financial companies need to actively manage the employee service because it assists in the creation of a company's service brand. In implementing this, it is important to deliver value to employees that improve the level of employee satisfaction and result in good performance in their jobs, which will positively influence customers' experiences in the employee-customer interaction. Many managers believed the way to motivating service employees is to reward workers with money, bonuses, or raises (Timmreck, 2001).

Nevertheless, the work itself can provide job satisfaction because the task is fulfilling or enjoyable. Intrinsic job satisfaction may be psychological rewards employees get simply from doing their jobs. It may be that when service staffs are intrinsically motivated by their jobs, they look for optimal ways to serve customers. This type of motivation is quite different from extrinsic motivation which is about the material value one gets from others such as pay raises and bonuses. Although extrinsic motivations are important, they are normally not enough to keep service employees at their best (Snipes *et al*., 2005). It is suggested that managers should increase intrinsic job satisfaction as employees' perception of the job itself which may have a larger influence on service quality than other satisfaction factors. Aspects regarding to pay, contingent rewards, and operations have less of an effect on employees' service performance than intrinsic dimensions. It is explained that with extrinsic motivation, employees focus more on the rewards rather than the work itself, so work only well enough to get the rewards (Snipes *et al*., 2005). In addition, it is supported that financial services are quintessentially knowledge-intensive business (Grant and Venzin, 2009). Human resource management has to provide training opportunities to employees frequently, the environment for creativity and mentoring its.

Banks should build a social culture that focuses on friendly relationships among coworkers, adopt a "people-first" attitude, and offer interesting and challenging tasks for workers. Aforementioned, core service made up brand evidence, financial institutions should invest more to improve and expand core service. The financial products and services vary depending on customers' needs. Beside the current services such as loan, saving account, credit card, financial companies develop other services such as insurance, investment account. Insurance services should be variety with asset of basic demands such as motor vehicle insurance and homeowner's/renter's insurance; and another kinds of insurances regarding to health and income such as life insurance, disability income insurance are increasingly concerned (Lee, 2002). In term of investment accounts, financial institutions should consult those types of accounts in developed countries such as annuity accounts, retirement savings plan, asset management/investment management account, and packaged/ relationship banking accounts (Lee, 2002). In addition, financial institutions need to provide their products and services through different channels of delivery to meet the variety needs of customers (Krishnan *et al*., 1999). Since the right choice of channels of delivery can facilitate not just the marketing of products and services but also long-term relationship building (Baker *et al*., 1998). According to the results of T-test (table 5 and 6) that young generation was more appreciation the role of core service than old generation.

Therefore, financial companies should investigate a right mix of products and services to a right segment of customers to attract more purchasers. Furthermore, this is recommended that managers should indentify which types of customers desire which financial products and services and which types of delivery channels human interaction or computer transaction. The purpose here is providing the right mix of financial products and services to the right segment of customers through the right channels of delivery. In general, financial institutions should provide various their products and services to the right mix of segment customers through different delivery channels to meet the different demands of customers. The right choice of products and services with the right delivery channels can facilitate not only the marketing of products but also long term relationship building.

Self-image congruence plays an important role in determining customers' experiences. The higher congruity between brand personality, customers' self-concept and his/her image of other customers related to more stimulating, exciting, enjoyable, and interesting of brand experiences (Hosany and Martin, 2012). Financial marketers should develop distinctive brand positions reinforcing the perceived image/personality of the typical financial customers. Marketers should also develop an image closely matching the self-perception of potential customers. Financial marketers must adapt their advertising messages to target customers' self-concept. In addition, managers need to understand the role of self-image congruence, experiences in explaining word-of-mouth information. This finding suggested self-image congruence influences customers' experiences and through perception predicts intention to recommend. Creating positive impression generates higher perception levels and positively influences customers' behavioral intentions (Hosany and Martin, 2012).

The result inferred that brand name is factor of brand evidence. Therefore, understanding the driver that contribute to and detract from the strengthening of brand evidence is critical. Prior research suggested that by using an original, creative and different advertising strategy, companies can develop higher brand awareness and position perceptions of their brands (Buil *et al*., 2011). Several managerial implications arise from these results. Advertising is an important marketing communication tool for service companies influencing brand evidence. Marketing strategy should be invested to increase higher awareness of customers on brand image. Financial companies should pay attention to the design of their advertising campaigns, ensuring they are attractive and creative. Finally, managers should pay attention to the causal order among brand equity dimensions.

Managers have to first build brand awareness as a mean of anchoring the different associations consumers have of a brand such as perceived value, personality or perceived

quality. Later, managers should focus on brand associations as a way of generating greater brand reputation.

Fuelled by the realization that brands contribute greatly to the overall value of firm's assets, and strengthening brand reputation is necessary in service branding context. However, to date the theme of branding in the context of banking services in emerging country has received very little attention. Therefore, in achieving empirical validation, the model about what factors made up brand evidence and how consumer perceives service quality according to demographic variables have made significant contributions to the existing service branding theory in financial sector. This model allows current understanding that employee service is important to boost brand evidence.

However, the study is not without limitations. Since the research is at its preliminary stage, it can be further strengthened by increasing the sample size and including participants in other geographical areas, considering the effect that consumption behavior may be affected by different regions. In addition, this study was only conducted towards one bank; future research can be conducted on some more banks, so the results will be compared according to rich dimensions.

CONCLUSION

In the study the dimensions of customer perceive brand evidence are explored, and thus provide directions for retail bank practitioners to enhance the customer perceived brand evidence. In the theoretical aspect, the result helps to establish a foundation for future development of a customer perceived brand evidence measurement scale specifically suitable for the retail banking industry in other contexts. It can also provide a theoretical base for further investigation on the relationship amongst brand evidence and other constructs.

REFERENCES

1. Alloza, A., (2008). Brand engagement and brand experience at BBVA, the transformation of a 150 years old company. Corporate Reputation Review 11, 371-381.
2. Ambler, T., Bhattacharya, C.B., Edell, J., Keller, K.L., Lemon, K.N., and Mittal, V., (2002). Relating brand and customer perspectives on marketing management. Journal of Service Research 5.
3. Bellizzi, J.A., and Hite, R.E., (1992). Environmental color, consumer feelings, and purchase likelihood. Psychology & Marketing 9, 347-363.

4. Berry, L.L., (2000). Cultivating service brand equity. Journal of the Academy of Marketing Science, 128-137.
5. Biswas, A., (1992). The moderating of brand familiarity in reference price perceptions. Journal of Business Research 25, 69-82.
6. Bowen, J., (1990). Development of a taxonomy of services to gain strategic marketing insights. Journal of the Academy of Marketing Science 18, 43-49.
7. Brakus, J.J., Schmitt, B.H., and Zarantonello, L., (2009). Brand experience; what is it? How is it measured? Does it affect loyalty? Journal of Marketing, 52-68.
8. Dall'Olmo Riley, F., and de Chernatony, L., (2000). The service brand as relationship builder. British Journal of Management 11, 137-150.
9. Davis, S.M., (2000). *Brand asset management*, Jossey-Bass Inc.
10. de Chernatony, L., Dall'Olmo Riley, F., (1998). Modeling the components of the brand. European Journal of Marketing 32, 1074–1090.
11. Degeratu, A.M., Rangaswamy, A., and Wu, J., (2000). Consumer choice behavior in online and traditional supermarkets: the effects of brand name, price and other search attributes. International Journal of Research in Marketing 17, 55-78.
12. Dodds,W.B., Monroe, K.B., and Grewal, D., (1991). Effects of price, brand, and store information on buyers' product evaluations. Journal of Marketing Research 28, 307–319.
13. Eastlick, M.A., and Feinberg, R.A., (1999). Shopping motives for mail catalog shopping. Journal of Business Research 45, 281–290.
14. Erdem, T., (1998). An empirical analysis of umbrella branding. Journal of Marketing Research 35, 339-351.
15. Franzen, G., (1999). Brands & advertising: How advertising effectiveness influences brand equity. Oxford shire, United Kingdom: Admap Publication.
16. Hosany, S., Ekinci, Y., and Uysal, M., (2006). Destination image and destination personality: an application of branding theories to tourism places. Journal of Business Research 59, 638-642.
17. Iacobucci, O., and Ostrom, A., (1994). Men and women: seeing services differently, Stores 76, 8-9.
18. Janiszewski, C., and van Osselaer, S.M.J., (2000). A connectionist model of brand-quality associations. Journal of Marketing Research 37, 331-350.
19. Keller, K.L., (1998). *Strategic Brand Management*. Prentice Hall, New Jersey.
20. Keller, K.L., and Hoeffler, S., (2002). Building Brand Equity Through Corporate Societal Marketing. Journal of Public Policy & Marketing 21, 78-89.
21. Kim, K.H., Kim, K.S., Kim, D.Y., Kim, J.H., and Kang, S.H., (2008). Brand equity in hospital marketing. Journal of Business Research 61, 75-82.
22. Kotler, P.H., (2006). *Marketing Management: analysis, planning, and control*. New

Jersey, Prentice-Hall.

23. Laroche, K.D., (2007). Building a strong services brand: lessons from Mayo Clinic. Business Horizons 50, 199-209.
24. Lassar, W., Mittal, B., and Sharma, A., (1995). Measuring customer-based brand equity. Journal of Consumer Marketing 12, 11-19.
25. Lim, K., and O'Cass, A., (2001). Consumer brand classification: an assessment of culture-of-origin versus country-of-origin. Journal of Product & Brand Management 10, 120-136.
26. Lovelock, C.H., and Gummesson, E,. (2004). Whither services marketing? In search of a new paradigm and fresh perspectives. Journal of Service Research 7, 20-41.
27. Mandel, N., and Johnson, E.J., (2002). When web pages influence choice: effects of visual primes on experts and novices. Journal of Consumer Research 29, 135-245.
28. O'Cass, A., and Grace, D., (2005). Service branding: consumer verdicts on service brands. Journal of Retailing and Consumer Service 12, 125-139.
29. Papist, Q., and Dimitriadis, S., (2012). Exploring consumer-brand relationship quality and identification. Journal of Qualitative Market Research 15, 33-56.
30. Pine, J.B., and Gilmore, J.H., (1999). *The experience economy; work is theatre and every business stage*, Cambridge, Ma; Harvard Business School Press.
31. Şahin, A., Zehir, C., and Kitapç1, H., (2011). The effects of brand experiences, trust and satisfaction on building brand loyalty; An empirical research on global brands. Procedia Social and Behavioral Sciences 24, 1288-1301.
32. Schmitt, B., (1999). Experiential Marketing. Journal of Marketing Management 15, 53-67.
33. Shimp, T.A., (1993). Promotion Management and Marketing Communications, The Dryden Press, Fort Worth, TX.
34. Snyder, D.R., (1991). Demographic correlates loyalty in frequently purchased consumer services. Journal of Professional Services Marketing 8, 45-55.
35. Sweeney, J.C., and Soutar, G.N., (2001). Consumer perceived value: the development of a multiple item scale. Journal of Retailing 77, 203-220.
36. Zeithaml, V.A., (1988). Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence. Journal of Marketing 52, 2- 22.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

LIFE INSURER FINANCIAL MANAGEMENT: SPACE RISK ANALYSIS IN THE CASE OF POLAND

PhD Adam, Sliwinski Warsaw School of Economics, Poland
Email: asliwin@sgh.waw.pl

ABSTRACT

The aim of this paper is to demonstrate the effect of the regional death risk differentiation approach upon the financial management and profitability of life assurance companies. Such an aim involves answering the question of whether the application of regional death risk differentiation in the process of financial management at insurance companies can improve their financial performance? The above issue was explored on the basis of empirical research undertaken by the author. The research followed the pattern of premium differentiation for the main categories of assurance by regions in Poland. The research reveals that the application of the regional differentiation method indisputably results in the improvement of financial performance of insurance companies, without compromising the fundamental principles of the insurance business, (principle of equilibrium). By employing the regional differentiation method, an insurance company optimises its profitability, while at the same time maintaining the structure of deposits and investments.

INTRODUCTION

The economic processes taking place Ester and Central European countries in recent years has affected also the broad insurance sector. The social and economic transformations, the break up of monopolies and intensifying competition contributed to the development of business insurance. This is demonstrated by both the growing numbers of entities offering insurance products and the increase of the written premium per capita from US$ 5.00 in 1991 to some US$ 300.00 in 2010[1].

Despite such strong growth, the Polish insurance sector is still lagging considerably behind the Western economies. For example Polish insurance market accounts of 1,1% in total European market. The number of life insurance companies operates in Poland is equal to 33 where in UK for example the number reaches the level of 1300[2]. While the Polish insurance market is generally believed to be in the growth stage, it is of particular significance given the integration of Poland with the economic system of the European Union. EU integration and the progressing globalisation of financial services created a need for on-going monitoring and a revision of the current operating strategies, notably in their financial aspect. Many enterprises, mainly in the production sector, do not take out property insurance or refuse to provide life assurance or health insurance cover to their workforce quoting the need to cut costs as the reason.

[1] Data concerning Polish market. Own calculations based on Polish Insurance Chamber Statistics.
[2] *European market in Figures 2011*, CEA Statistics no 44, December 20122

The continued development of the insurance sector is in the interest of the insurance companies operating in Poland. Insurance companies should seek to optimise their financial performance and to improve the flexibility of their insurance services to contribute to improving the financial standing of the insured businesses and households as well. This is possible by an on-going search for factors improving the competitiveness of businesses and increasing insurance awareness among the general public. This is a difficult challenge. One of the success factors is the ability to combine the efforts of the management teams of insurance companies with research findings.

The increasing attractiveness of the insurance market in Poland results in a rapid growth of competition. The tough competition forces insurance companies to take specific actions which should, above all, seek to improve flexibility via product and organisational innovation. The strong competition creates the need to look for ways to optimise the performance of insurers, and to develop on a continuous basis new insurance products that meet the needs of customers. The products should fully meet the needs of customers at the lowest possible insurance premiums.

On the other hand the product should assure financial stability of insurance companies and ultimately ability to pay insurance claims. This is particularly important in the case of life assurance. The long-term nature of life assurance and the special nature of the attendant insurance risk (being the risk of death) renders the financial management at insurance companies offering life assurance products highly difficult and complex. Each decision has specific ramifications for a period of several, or even a dozen or so, following years.

There are few publications, either in Poland or in the world, examining in detail the risk of death and the application of the findings in assurance processes. It is even more difficult to find sources explaining and demonstrating the effect of regional differentiation of insurance (rates) premiums on the financial management of insurance companies. There are a number of research that examine effect on different factors on the purchases of insurance product from costumers side in the case of CEE countries[3]. However it is very difficult to find a study that examines the effect of regional risk differentiation on life insurance companies profitability by affecting insurance rates.

The aim of this paper is to demonstrate the effect of the regional death risk differentiation approach upon the financial management and profitability of life assurance companies. Such an aim involves answering the question of whether the application of regional death risk differentiation in the process of financial management at insurance companies can improve their financial performance?

The above issue was explored on the basis of empirical research undertaken by the author. The research followed the pattern of premium differentiation for the main categories of assurance by regions in Poland. Net premiums were used for comparison, excluding the costs of insurance operations.

[3] Look for example: A.Sliwinski, T.Michalski, M. Rószkiewicz, Demand for Life Insurance—An Empirical Analysis in the Case of Poland, *The Geneva Papers on Risk and Insurance,* 2013, 38, pp. 62-87,

1. Death Risk by regions in Poland

One of the key factors affecting assurance net premium level is the extent of risk covered by insurance, which in this case is the risk of death. The probability of death is a measure of death risk. Based on an examination of changes in the probability of death, one can make certain generalisations and draw consolidated conclusions on the death rate patterns in the population inhabiting a relevant region.

This part of the paper will focus mainly on presenting the differences in the probability of death by region. The differences may appear in the level of the calculated probability of death for individuals of various ages residing in specific regions, and may affect the level of premiums.

The table below presents the death probability figures for men aged from 18 to 30 for the Mazowieckie region and the corresponding figures calculated for the whole of Poland in 1997.

Table 1. Death Probability for Men in Mazowieckie Region vs. Death Probability for Men in Poland.

Age	Mazowieckie	Poland	DIFFERENCE
A	B	C	C-B
18	0.00125	0.00115	**-0.00010**
19	0.00146	0.00131	**-0.00015**
20	0.00124	0.00136	**0.00012**
21	0.00165	0.00136	**-0.00029**
22	0.00175	0.00135	**-0.00040**
23	0.00138	0.00135	**-0.00003**
24	0.00161	0.00138	**-0.00023**
25	0.00163	0.00144	**-0.00019**
26	0.00153	0.00151	**-0.00002**
27	0.00147	0.00159	**0.00012**
28	0.00174	0.00166	**-0.00008**
29	0.00190	0.00174	**-0.00016**
30	0.00210	0.00184	**-0.00026**

Source: Author on the basis of *Trwanie zycia w 1997* (*Tabels of life 1997*), GUS (Main Statistical Office), Warsaw 1998.

As demonstrated clearly by the results, the death probability figures are different for different regions. For example, for a 30-year-old assured individual, the probability of death calculated on the basis of the Dolnoslaskie Region data is 0.001202. The equivalent probability, for example, in the Podlaskie Region is 0.000990, a difference of 17 percent. Similar differences occur for the other regionsand for the regional data-based death probability figures vis-à-vis death probability figures calculated for the whole of Poland, without regional differentiation. The differences are present in both men and women.

The resulting regional differences may cause differentiation of net premiums. One can therefore conclude that by applying the regional differentiation method, insurance companies can shape net premiums as appropriate. The death probability assessment methods and formulae used to calculate premiums are listed in Appendix 1.

2. Regional Comparison of Net Premium – Profitability Regions

The insurance premium embodies the obligation of the insurant towards the insurer for insurance cover during the period of insurance. The insurance premium is therefore the price of the insurance service, and therefore one of the most important considerations taken into account when selecting an insurance company. In emerging markets, where the insurance awareness is low, the premium level often becomes the only selection factor. This approach can bring immeasurable losses if the premium level is without justification established too low. Under the current circumstances, in an attempt to improve their financial performance, insurers should offer lowest practicable premiums ensuring realistic insurance cover to the customers and security to the insurance company.

One of the main objectives of the research presented is to demonstrate the effect of the regional differentiation method upon the level of life assurance premiums. The level of gross premiums is a direct derivative of net premiums. The differences in net premiums calculated on the basis of regional data will result in a proportional reduction of gross premiums. Given the above, the differences in the level of net premiums will likewise affect the final price of the insurance cover service.

In long-term life assurance, the level of net premiums is directly dependent on the average death risk for the period of insurance and the assumed technical interest rate. The net premium is calculated on the basis of the probability of death, assumed longevity and the probable period over which the insurance premium is expected to be paid. The calculations presented are based on the death risk analysis in the individual regions of Poland. The premiums have been calculated on the basis of regional (voivodeship) statistics (NUTS II) and compared with the currently effective net premiums. The Polish insurance market is a relatively young, maturing market. The majority of insurance companies do not maintain in-house statistics and rely on the premium tariffs calculated on the basis of death rate materials pertaining to the national population. The calculations presented apply to “pure” insurance, i.e. whole-life insurance, endowment insurance and pure endowment insurance. The calculations refer to the minimum sums of insurance specified under the general terms of insurance offered by the largest insurance companies operating in Poland. The calculations pertain to individuals from 18 to 35 years of age. This age group is the most numerous group of insurance company customers. The death probability figures assessed on the basis of regional data differ from those established with reference to the national statistics. It is this difference that affects the level of net life assurance premiums.

* R – is the difference between the premium level calculated based on national data and region-specific premiums.

Due to quantitative limitations and in order to maintain a clear structure of the paper, the comparisons below are presented for the Mazowieckie Region. Similar differences are found in the other regions of Poland. The calculation results are shown as charts presenting the relationship of the resulting differences (R)* in the level of premiums relative to the age at which the insurance is taken out. The charts below present the results of calculations and the attendant differences in the case of whole-life insurance, pure endowment insurance and endowment insurance.

Figure 1. Net Premium Comparison – Whole Life Insurance.
Source: Author.

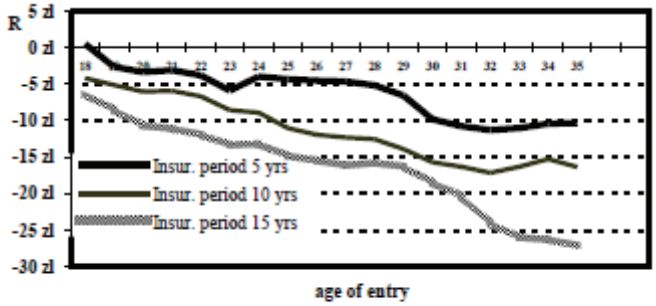


Figure 2. Net Premium Comparison – Pure Endowment Insurance.
Source: Author.

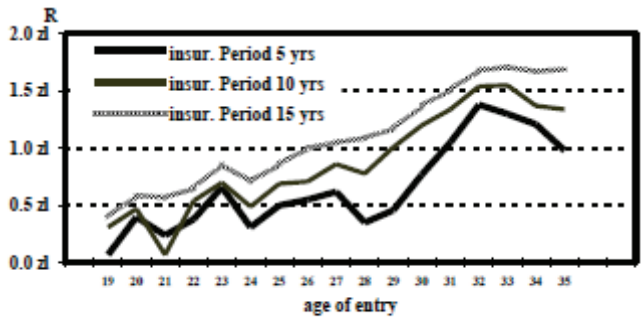


Figure 3. Net Premium Comparison – Endowment Insurance.
Source: Author.

The comparison has shown a difference in the annual net premiums calculated for the national statistics vs. based on the Mazowieckie Region data. The premiums calculated based on the regional data are lower than the premiums based on national statistics. Similar differences apply

to the other regions. While the insurance is taken out for several years and the group of the insured is quite numerous, this may have significant impact on the financial management of insurance companies and their profitability. Employing the regional differentiation method, the life assurance company may, while maintaining the fundamental insurance principles, reduce the level of premiums. The reduction will by no means endanger the financial viability of the insurance company.

In the case of endowment and mixed insurance, premiums calculated on the basis of the voivodeship data differ from the premiums established on the basis of the average national data. In the case of endowment insurance, the level of premiums based on regional data is higher than premiums based on national data. From the point of view of insurance companies, it would be unjustified to apply the regional differentiation method in this type of insurance. In practice, the endowment insurance does not occur as pure insurance. The reason is that, in this case, the insured would lose all the money collected upon his/her death. Mixed-type insurance is more beneficial to the customer.

An analysis of the arising difference reveals a certain pattern. In the case of life assurance, the difference grows with the age of the person taking out the insurance. This regularity does not occur in the case of mixed insurance. In mixed insurance, the resulting differences clearly depend on the period of insurance. For a period of 10 years the difference is twice as big as for five years of the insurance period. The longer the insurance period, the bigger the difference. Here, unlike in the case of life assurance, there is no clear dependence between the premium amount and the age of the insured.

As clearly demonstrated by the research conducted and the comparison between the amount of premiums calculated for regional data vis-à-vis national statistics, the regional differentiation method does affect the level of premiums calculated. As insurance premiums are the key source of income for insurance companies, any significant change in their level is bound to impact significantly upon their financial management.

The findings of the research and the conclusions drawn on the basis of the analysis of regional risk in Poland indicate that Poland has two areas with a similar type of risk. For these areas insurance companies could apply standardised premium tariffs. The list below presents a preliminary division of regional voivodeships together with their characteristics.

their characteristics.

Group I	Characteristics	Group II	Characteristics
Podlaskie		Dolnośląskie	
Podkarpackie		Kujawsko-Pomorskie	
Lubelskie		Warmińsko-Mazurskie	
Łódzkie		Lubuskie	
Świętokrzyskie	Higher average probability of death	Opolskie	Lower average probability of death compared to Group I
Małopolskie		Pomorskie	
Mazowieckie		Wielkopolskie	
		Śląskie	
		Dolnośląskie	
		Zachodniopomorskie	

Source: Author.

For specific ages, the premiums calculated on the basis of Group II regions are lower than the premium based on the average national statistics. The table below presents the irregularity of regional premium distribution as exemplified by life assurance. The irregularity factors were calculated using the following formula:

$$A = \frac{n\sum_{i=1}^{n}(x_i - \bar{x})^3}{(n-1)(n-2)\hat{S}_x^3} \quad (1)$$

where:

n – number of regions,

x_i – premium level in a specific region (voivodeship),

$\bar{x}$ - average premium level,

$\hat{S}$ – standard deviation.

Table 3. Irregularity of Regional Premium Distribution Irregularity as Exemplified by Whole Life Insurance.

Age	Average Premium Level	Skewness
18	0.00451	-0.2195
27	0.00683	0.0089
35	0.01015	0.2057

Based on the analysis presented, an insurance company is capable of optimising the premium level by dividing the country into profitability regions. This requires further detailed statistical research. For the regions defined, the insurer should vary the premium policy, thus maximising the value of the company and its profitability levels.

The calculation of insurance premiums is among the key tasks of the insurance company. This is because premiums, besides benefits and claims, are a principal item of cash flows and the profit and loss account of insurance companies. The premiums paid by insurants are the main item of revenues, while benefits and claims are principal cost items. The operational viability of an insurance company calls for equilibrium between the level of premiums, on the one hand, and the level of benefits and claims, on the other. This is above all due to the fact that the insurance company manages an insurance fund established from the premiums collected. The insurance company's equity is only secondary in balancing its revenues and expenditures. The size of the insurance fund depends on the projected incidence of future events covered by the insurance. One of the basic principles of the insurance company financial management is that of equilibrium between benefits and premiums. This principle requires a balance between the insurance fund, driven by the premium level, and the level of benefits and claims.

FINANCIAL MANAGEMENT AND REGIONAL PREMIUM DIFFERENTIATION

The level of premiums directly affects the size of the insurance fund from which the insurance company meets its obligations in the form of benefits and claims. In the light of the above, as a generalisation, it can be stated that the technical profit generated by the insurance company depends on the size of the fund and the level of benefits and claims paid by it. The increase in the technical profit on the insurance activities will directly affect the overall profit. While the capital structure of the insurance company is maintained, better overall profit will translate into improved profitability. Therefore, if the regional differentiation method increases the value of the balance of the insurance fund – net of benefits and claims – the application of the method will affect the profitability of the insurance company's capital. The impact of the presented method on the value of the insurance fund is shown in Table 4 which compares the course of endowment insurance up to 65 years of age for a group of 10,000 men aged 55, with the insurance amount of PLN 1,000**. The calculation rests on the assumption that the premium paid amounts to PLN 90 and death benefits are payable on 31 December of each year. The technical interest rate is 5 percent. The tables below present results obtained for the Mazowieckie Region. The number of the deceased in a given year follows from the 1999 probability of death calculation for the Mazowieckie Region.

As indicated by the presented data, after the benefits relating to the insurance cover are paid, the application of the regional differentiation method results in an increase of the balance of the insurance fund by some 38.5 percent for the Mazowieckie Region.

** The results of calculations for the Mazowieckie Region were compared with the calculations for such insurance presented in E. Stroiński, *Ubezpieczenia na życie* (*Life Assurance*), LAM, Warsaw 1996, p. 110.

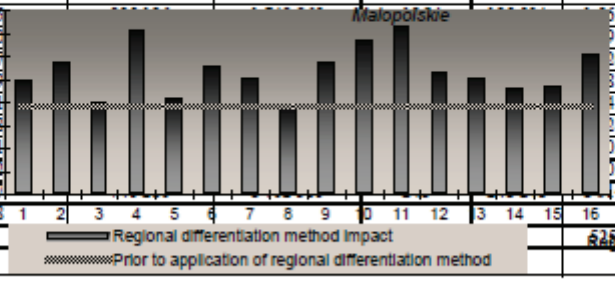
Table 4. **Impact of the Regional Differentiation Method on Insurance Fund Value.**

Age	Number of insured	Current year premium	Current year premium plus residual from previous years after interest	Number of deceased in given year	Value of death benefits	Fund balance net of benefits	Value of endowment benefits
55	10 000	900 000	945 000	173	173 000	772 000	
56	9 827	884 430	1 739 251	183	183 000	1 556 251	
57	9 644	867 960	2 545 422	194	194 000	2 351 422	
58	9 450	850 500	3 362 018	207	207 000	3 155 018	
59	9 243	831 870	4 186 232	220	220 000	3 966 232	
60	9 023	812 070	5 017 217	232	232 000	4 785 217	
61	8 791	791 190	5 855 227	245	245 000	5 610 227	
62	8 546	769 140	6 698 335	257	257 000	6 441 335	
63	8 289	746 010	7 546 712	267	267 000	7 279 712	
64	8 022	721 980	8 401 777	276	276 000	8 125 777	
65	7 746						7 746 000
Balance						**379 777**	

Source: E. Stroiński, *Ubezpieczenia na życie* (*Life Assurance*), LAM, Warsaw 1996, p. 110.

Table 5. **Impact of the Regional Differentiation Method on Insurance Fund Value.**

Age	Number of insured	Current year premium	Current year premium plus residual from previous years after interest	Number of deceased in given year	Value of death benefits	Fund balance net of benefits	Value of endowment benefits
55	10 000	900 000	945 000	165	164 600	780 400	
56						63 271	
57						51 032	
58						29 071	
59						31 470	
60						45 238	
61						27 937	
62						03 933	
63						03 820	
64						14 113	
65	7 988						7 988 261
						525 852	
						146 075	



Source: Author.

Figure 4. Value of Insurance Fund Balance by Region as Exemplified by Endowment Insurance.
Source: Author.

Similar differences are found in the other regions (see Table 6). Figure 4 shows a comparison of the insurance fund balance calculated for the national data and following application of the regional differentiation method. The application of the regional differentiation method results in an increase of the insurance fund balance. A slight decrease was only found in the Lodzkie Region. In the other regions the fund increases on average by 40.7 percent. In the Malopolskie Region the fund was up by 91.41 percent. It should be borne in mind that the analysis rests on a set of assumptions. The assumed number of the insured (10,000) is particularly important. The increases may be even higher for higher numbers of the insured.

The increase of the insurance fund balance has a direct impact upon the technical result of the insurance company. The better the technical financial result, the better the overall performance. Improved financial performance, in terms of both the technical and overall result, affects the profitability of the insurance company. The technical result drives the technical operations profitability ratio, which demonstrates the technical result as a percentage of premium generated on their own contribution. The higher the ratio, the better the standing of the insurance company.

High profitability means a speedy return of the capital employed by the owners to finance the insurance company and a high operational effectiveness. The research findings presented demonstrate that the regional differentiation method, by affecting the insurance company financial management, improves both technical and overall profitability of the business. Assuming that technical operating costs account for 30 percent of total costs, the application of the method would result in a improvement of the return on sales by some 10 percent. Better return on sales directly improves the return on equity and return on total capital of the insurance company. In a free market economy, in a highly competitive environment and where the investment ofcapital by insurance companies is legally restricted, this rate of increase should be seen as significant. The above profitability improvement may strengthen the competitiveness of an insurance company in the market.

Table 6. Value of Insurance Fund Balance by Region.

	Region	Value of insurance fund balance	% difference
1.	Dolnośląskie	PLN 491 045	29.30%
2.	Podlaskie	PLN 572 049	50.63%
3.	Kujawsko-Pomorskie	PLN 394 524	3.88%
4.	Podkarpackie	PLN 708 872	86.65%
5.	Warmińsko-Mazurskie	PLN 412 243	8.55%
6.	Lubelskie	PLN 551 125	45.12%
7.	Lubuskie	PLN 506 850	33.46%
8.	**Łódzkie**	**PLN 376 056**	**-0.98%**
9.	Opolskie	PLN 576 029	51.68%
10.	Świętokrzyskie	PLN 667 569	75.78%
11.	**Małopolskie**	**PLN 726 934**	**91.41%**
12.	Mazowieckie	PLN 525 852	38.46%
13.	Wielkopolskie	PLN 506 686	33.42%
14.	Zachodniopomorskie	PLN 458 554	20.74%
15.	Śląskie	PLN 470 019	23.76%
16.	Pomorskie	PLN 605 923	59.55%

Source: Author.

Summing up, it needs stressing that the application of the regional differentiation method indisputably results in the improvement of financial performance of insurance companies, without compromising the fundamental principles of the insurance business, in particular the principle of equilibrium between benefits and premiums. By employing the regional differentiation method, an insurance company optimises its profitability, while at the same time maintaining the structure of deposits and investments.

The regional differentiation method could be applied in the process of developing a competitive advantage of insurance companies. The application of the method would result in dividing the common European market into the profitability regions, as those referred to above. The division would be based on the analysis of the risk of death in the individual regions of the European Union. The operational strategy driven by profitability regions will help strengthen the competitive edge over other insurers and secure the market position. However, before this strategy can be implemented, extensive research on the death risk in the European Union is necessary. The research should cover a period of several years to eliminate accidental variations. This is a very difficult task requiring financial expenditures as well as collecting a large body of requisite data, as a basis for analysis. The results could help identify European profitability regions for which it would be profitable to apply standardised premium tariffs.

The area of the European Union has been divided into *Nomenclature of Territorial Units for Statistics* (NUTS). The main purpose of the division is to single out territorial units for which statistical data would be collected. The data, collected by Eurostat, is used to assess the economic development in the individual regions. Insurance companies to assess the risk in the NUTS and to calculate insurance premiums could then use the data collected for the individual regions.

At the moment, in the EU there are 77 NUTS I regions, 206 NUTS II regions, 1031 NUTS III regions, 1,074 NUTS IV regions, and 98,433 NUTS V regions. The table below shows the division into NUTS units in the EU countries.

Table 7. **Nomenclature of Territorial Units for Statistics**

Country	NUTS 1		NUTS 2		NUTS 3		NUTS 4		NUTS 5	
Austria	Gruppen von Bundeslaendern	3	Bundeslaender	9	Gruppen von Politischen Bezirken	35	-	-	Gemainden	2351
Belgium	Regions	3	Provinces	11	Arrondissements	43	-	-	Communes	589
Denmark	All country	1	All country	1	Amter	15	-	-	Kommuner	276
Greece	Groups of development regions	4	Development regions	1	Nomoi	51	Eparchies	150	Demoi/Koinotites	5921
Germany	Laender	16	Regierungs-bezirke	38	Kreise	445	-	-	Gemeinden	16176
Spain	Agrupacion de comunidades autonomas	7	Comunidades autonomas + Ceuta i Mellila	18	Provincias + Ceuta i Mellila	51	-	-	Municipios	8077
Finland	Manner-Suomi /Ahvenanmaa	2	Suuralueet	6	Maakunnat	19	Seutukunnat	88	Kunnat	455
France	Z.E.A.T + DOM	9	Regions +DOM	26	Departments + DOM	100	-	-	Communes	36664
Ireland	All country	1	All country	1	Regional Autority Regions	8	Counties/County boroughs	34	DEDs/Wards	3446
Luxemburg	All country	1	All country	1	All country	1	Cantons	12	Communes	118
Holland	Landsdelen	4	Provincies	12	COROP regio's	40	-	-	Gemeenten	672
Portugal	Continente + Regioes autonomas	3	Comissaoes de coordenacao regional + Regioes autonomas	2	Grupos de Concelhos	30	Concelhos-municipios	305	Freguesias	4202
Sweden	All country	1	Riksomraden	8	Lan	24	-	-	Kommuner	286
Italy	Gruppi di regioni	11	Regioni	20	Provincie	103	-	-	Comuni	8100
Great Britain	Standard regions	11	Groups of counties	35	Counties/Local authority regions	65	Districts	485	Wards/Communities/Localities	11095

Source: A.M. Gmyrek, *Nomenklatura statystyczna NUTS-działania dostosowawcze Polski,* „Wspólnoty Europejskie" Nr 6(106) 2000, s.22

The differentiation into the NUTS units could be a factor justifying the regional insurance policy. The research at the NUTS II level also seems justified. While NUTS II and I, have the most extensive statistics, research conducted at the NUTS I level can turn out too general.

By examining the findings of research based on regional data in Poland and given the differentiation into NUTS units in the European Union, one can presume that differentiation of the premiums for the individual regions would have similar financial ramifications for life assurance companies. Using the death rate data in the individual NUTS units, insurance companies could optimise premiums based on an analysis of the insurance risk. This would undoubtedly lead to an increase of the balance of the insurance fund and consequently improve the profitability of the insurance business.

REFERENCES

Books, Monographs

1. Banasinski A., 1997, *Business Insurance*, Warsaw, Poltext
2. Bowers, N.L. Jr., Gerber H.U., Hickman, D.A. Jones, C.J. Nesbit 1986*, Actuarial Mathematics,* The Society of Actuaries,
3. Drucker P.F., 1994, *The Practice of Management,* Krakow, University of Economics,
4. Lancucki J., 1996,*Principles of Business Insurance Finance*, PWN,
5. Handbook ed. Monkiewicz J*,* 2000, *Principles of Insurance vol. I – Mechanisms and Functions,* Warsaw, Poltext,
6. Sliwinski A., Michalski T., Rószkiewicz M., Demand for Life Insurance—An Empirical Analysis in the Case of Poland, *The Geneva Papers on Risk and Insurance*, 2013, 38, pp. 62-87,
7. Stroinski E., 1996, *Life Assurance,* Warsaw, LAM,

Data source

1. *Tables of life 1997*, Warsaw, Central Statistical Office,
2. Database of Central Statistical Office in Warsaw, Poland

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

APPENDIX

Appendix 1

I. The probability of death calculated as the incidence of death in a population of people aged "*x*" before they reach the age of "*x+1*". The calculations also take migration into account.

$$q_x = 1-(1-q_x^{'})(1-q_x^{''})$$

In the above formula, the auxiliary variables $q_x^{'}$ and $q_x^{''}$ are calculated as follows:

$$q_x^{'} = \frac{\sum_t D_x^{'}(t)}{\sum[P_x(t-1)-0{,}5*R_{x+1}(t)]}; \qquad q_x^{''} = \frac{\sum_t D_x^{''}(t)}{\sum_t[P_x(t)+D_x^{''}(t)+0{,}5*R_x(t)]}$$

where:

$P_x(t)$ – number of living people aged *x* at the end of year *t*,

$B(t)$ – number of births in year *t*,

$D_x^{'}(t)$ – number of people *x* years of age deceased in year *t* among those born in year *t-x-1*,

$D_x^{''}(t)$ - number of people *x* years of age deceased in year *t* among those born in year *t-x*,

$R_x(t)$ – adjustment of the population due to migration in year *t* of people born in year *t-x*.

The adjustment of the population due to migration was calculated using the following formulae:

$$R_x(t) = [P_{x-1}(t-1) - P_x(t) - D_{x-1}^{'}(t) - D_x^{''}(t)]$$

$$R_0(t) = B(t) - P_0(t) - D_0^{''}(t)$$

II. The premiums were estimated using the following formulae:

1. Whole Life Insurance

The whole-life insurance can be described as the insurer's obligation to pay the party named in the policy upon the insurer's death a pre-agreed sum of money, regardless of whether the death occurs.

In accordance with the principle of equivalence of premiums and benefits:

$$l_x A_x = vd_x + v^2 d_{x+1} + v^3 d_{x+2} + \ldots + v^{w-x} d_w$$

Assumption:
- benefit equal to PLN 1.00.

Therefore, a single premium would be:

$$A_x = \frac{vd_x + v^2 d_{x+1} + v^3 d_{x+2} + \ldots + v^{w-x} d_w}{l_x}$$

Multiplying the numerator and the denominator by v^x gives:

$$A_x = \frac{v^{x+1} d_x + v^{x+2} d_{x+1} + v^{x+3} d_{x+2} + \ldots + v^w d_w}{v^x l_x}.$$

Introducing an additional commutative function C_x instead of $v^{x+1} d_x$, and C_{x+1} instead of $v^{x+2} d_{x+1}$ and applying the commutative function D_x gives:

$$A_x = \frac{C_x + C_{x+1} + C_{x+2} + \ldots + C_{x+w}}{D_x}.$$

In actuarial mathematics a sequence of numbers $C_x+C_{x+1}+C_{x+2}+\ldots+C_{x+w}$ is designated with a symbol (commutative number) M_x. Then the formula is as follows:

$$A_x = \frac{M_x}{D_x}$$

2. Pure Endowment Insurance

Pure endowment insurance is an insurance under which the benefits are paid only to those who have survived the period of insurance.

The equivalence principle can be represented thus:

$$l_x {}_nE_x = v^n l_{x+n}.$$

Solving this formula:

$${}_nE_x = \frac{v^n l_{x+n}}{l_x} = v^n {}_np_x.$$

The formula uses the survival probability for person's aged x in a period of n years. This formula can also be represented as a commutative function in which case the numerator and the denominator of the above formula have to be multiplied by v^x.

Introducing additional commutative functions C_x instead of $v^{x+1} d_x$, and C_{x+1} instead of $v^{x+2} d_{x+1}$ and using the commutative function $D_x = v^x l_x$ gives:

$${}_nE_x = \frac{v^{x+n} l_{x+n}}{v^x l_x} = \frac{D_{x+n}}{D_x}$$

3. Endowment Insurance

A endowment insurance is an insurance under which the benefits are paid upon death in the period of insurance and also when the insured survives the period of insurance.

The endowment insurance can be treated as the sum of periodic insurance and pure endowment insurance. A single premium in the endowment insurance is calculated using the symbol $A_{x:n/}$ and it is the sum of premiums from periodic insurance and pure endowment insurance. This is represented as follows:

$$A_{x:n} = A^1_{x:n/} + {}_nE_x.$$

Using the commutative numbers gives:

$$A_{x:n} = \frac{M_x - M_{x+n}}{D_x} + \frac{D_{x+n}}{D_x} = \frac{M_x - M_{x+n} + D_x}{D_x}.$$

Commutative functions:
$C_x = v^{x+1} d_x$
$C_{x+1} = v^{x+2} d_{x+1}$
$D_x = v^x l_x$

Assumptions:
- single premium,
- benefit equal to PLN 1.00.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

CAN HEURISTIC VALUATION IMPROVE INVESTMENT PERFORMANCE OF INDIVIDUAL INVESTORS?

Mariusz Kicia, Ph.D., Maria Curie-Sklodowska University, Lublin, Poland
mariusz.kicia@umcs.lublin.pl

ABSTRACT

The paper presents concept of simplified valuation models and tests their usefulness in application by individual investors at the Polish stock market over 2000-2013. It is discussed whether it would be rational to combine common fundamental valuation methods of multiples and DCF, preserving the relative simplicity of multiples as well as complexity and consistency of discounted cash flows to provide useful hybrid tool even when individual investors follow behavioral heuristics and simplifications while making investment decisions. Results of experiments indicate that use of proposed valuation methods wouldn't have an unequivocal impact on investment strategy of irrational individual investors with quite a low average improvements of annual returns (from 5,2% to 10,5% extra return) only in about a half of all 415 analyzed stocks. Tests are preceded by results of the survey conducted on 66 experienced and 136 inexperienced individual investors to compare their investment techniques and attitudes. It is shown that rising experience in investment causes investors to follow intuition in risk assessment that may end in overconfidence. 74% of respondents without experience declared that they would measure investment risk in some way while practitioners usually don't use measures but rather sense risk. Inexperienced respondents are more likely to use Fundamental Analysis tools than real investors in practice. Answers also suggest that the more investors are experienced the more often they declare using Technical Analysis tools.

Keywords: individual investor, behavioral finance, investment strategy.

INTRODUCTION

The development of the financial market with increasing number of instruments traded, capitalization, and above all number and variety of market participants should lead to an increase in the degree of efficiency, according to the Efficient Markets Hypothesis (EMH). The implications of EMH are very profound for investors. If the EMH is true, prices are fair and give the return investors deserve. Security prices are exactly what they should be, given what is known at the time. The fact that prices are constantly changing does not contradict this. Prices are simply reacting to new information and constantly being fine-tuned in order to stay up to date. In theory, markets with weak EMH mean that technical analysis is a waste of time. At best, clever fundamental analysis (i.e. examination of drivers of value such as profits, market share, growth etc.) might if accurate predictions could be made independent of past trends. This might be possible if there were talented investors who able to convert new information into securities fair value before the rest of the market could do the same. However, if there is semi-strong EMH, even fundamental analysis would not be productive since share prices would reflect the latest available information. This is because the "instantly up-dated" market – with thousands of decision-makers - will always be ahead of an individual analyst in trying to incorporate the impact of the latest news into securities prices.

If this is the case, paying a portion of investment wealth to a fund manager does not make sense. Better to simply invest in a widely diversified fund (index fund) that tracks a market overall based on random and un-researched selections. The other option is beat the market with insider trading but this possibilities usually are not instant or even if non-public yet information is available ahead of the whole market using them is against the law. If insider trading fails in a long term strong EMH appears as all decision-makers are able to predict correctly even information that is confidential at the moment and incorporate into prices. That is rather uncommon as even developed markets dynamics usually puts them somewhere between semi-strong and strong EMH.

The financial market volatility and efficiency of its functions depends to a great extent on the behavior of the market participants. With the current size of the financial markets and their growing international relationships an individual investor may obviously become less important, although to quite shallow and developing emerging markets individual investors may play a significant role in pricing securities. Even if we assume that the market efficiency provides the same information at the same time to all (or almost all) decision-makers the way it is incorporated into market prices varies not only according to investment strategies, investment horizon but depends on pricing method, risk perception, timing and formal restrictions in potential decisions. In that case individual investors may act different than institutions and if they are a leading group of the market agents an informal and intuitive process of incorporating information into prices can end in speculative bubbles. That's why individual investors are called *quasi rational* or *irrational*. Financial market activity of irrational investors leads to an increase in market volatility. Empirical studies show that only one third of changes in stock prices is a result of changes in fundamental factors that can be considered as drivers of rational expectations. The remaining part of the volatility of stock prices is largely the result of the activity of irrational investors.

Even if strong EMH appears everyone wants to beat the market. To achieve this goal financial market participants are driven by different factors and tools for making financial decisions. None of the tools and methods of analysis however doesn't explain complexity of market volatility. Technical Analysis is based on past volatility only and it does not refer to the basic mechanisms of price discovering as a highly simplified approach. Fundamental factors cannot be considered as the only drivers of market volatility. Behavioral analysis shows that the market asset value often differs significantly from prices considered as fair but it is not a coherent approach although explaining market behavior by the behavior of its participants focuses more and more attention.

The modern theory of finance does not pay much attention to the irrationality of investors. It was assumed that they were an easy prey for other investors who were involved in arbitrage or carrying out speculative transactions focused on mean reversion. On the other hand waves of optimism due to increases of stock market indices and the waves of pessimism due to their declines prevailing among individual investors can be a reason why stock prices diverge from the levels of their fundamental values. If irrational investors are convinced that shares should be bought or sold as soon as possible even against EMH, overestimated stock prices may still rise and underestimated keep falling. The described behaviors induce another kind of financial market risk, the risk of irrational investors that may be persistent. It is observed when even if mispricing of market asset prices appears values are not corrected quickly.

Rational investors follow the course of events assuming that since the fundamental value of stock follows random-walk process then stabilizing speculation even without irrational investors is risky as relationships between market prices and fundamental factors is not stable. The uncertainty of these compounds is an arena of irrational investors acting as noise traders than reacting to change in fundamentals (Focault, Sraer, Thesmar 2011).

The reason for such a behavior may be a lack of tools that allow individual investors to formally estimate the fair value of instruments that would be a reference value when making investment decisions. That says individual investors do not have the appropriate decision-making tools. They rather use their intuition or simplified calculations due to a problem with obtaining proper information, its interpretation and the time restrictions. Hence, the common practice of their formal valuation method are simple but often unreliable multiples. In the absence of a reference point decision-making becomes emotional and similar to gambling than a planned investment. On the other hand the formulation of comprehensive forecasts and expectations regarding the situation of issuers, predicting revenues, expenses, profits, cash flows etc. exceeds the capacity of most individual investors though is necessary when the most complete and reliable methods of valuation (DCF) is applied by institutional investors.

With all the above problems in mind the question arises whether it would be possible to combine both of these fundamental valuation methods, preserving the relative simplicity of multiples as well as complexity and consistency of discounted cash flows (DCF) to provide useful hybrid tool even when individual investors will follow behavioral heuristics and simplifications while making investment decisions.

The paper presents the concept of such a tool and tests its usefulness in application to still emerging Polish stock market over 2000-2013. The sample of 415 companies listed on the main market of the Warsaw Stock Exchange was the subject of experiments in three variants of the heuristic (simplified) valuation model. Simulations were provided to test whether the use of the heuristic pricing model would improve the performance (average returns on investment) of hypothetical individual investor's single-asset portfolio. Models were also tested on fundamental data from both stand-alone and consolidated financial statements. The concept of the model and its testing is preceded the review of empirical studies on the investment behavior of individual investors including surveys conducted by the author of the article with 66 experienced and 136 inexperienced individual Polish investors.

INVESTMENT BEHAVIORS OF INDIVIDUAL INVESTORS

General Framework of Behavioral Investing

Activities of bounded rationality investors in financial markets has its theoretical foundations in the behavioral finance. Under this approach, decision depends on the decision making process so it is important to analyze investor's behavior from the perspective of cognitive psychology, in particular regarding formation of judgments and behaviors that accompany it (Shefrin 2005, Sławiński 2006).

Despite the fact that radical behaviorism opposed to cognitive psychology assumes that the explanation of behavior is not necessary referring to internal mental processes more and more behavioral finance concepts derive from cognitive psychology. Cognitive psychology

explains many patterns of behavior that are useful from the financial markets perspective, including especially those which may lead to speculative asset price growth in the securities markets. Such behaviors cover methods of formulating judgments (heuristics) that in a fairly simple way allow for making decisions and solving problems. In psychology, the most important cognitive heuristics include: anchoring, availability, framing and representativeness. These heuristics can be often found in investors' behavior (De Bondt 1998).

Anchoring facilitates decision making under uncertainty by referring potential solutions to a real (or imagined) value which is the point of reference for decision to be taken. Selecting the reference point is an important issue since depending on anchor the same decisions may be considered as profits or losses, causing other heuristics (e.g. mental accounting and adjusting appetite for risk). In financial investment anchoring enforced with availability heuristic (recalling information easily accessible in memory but not necessarily correct at the moment) appears frequently at the moment of security purchasing decision. Perception of current market prices level as reasonable and worth investment can be caused by media, reports already outdated or informal information from people who seem to be reliable (myth of expert). However anchoring lasts even longer when new information that should influence decisions and prices is ignored causing underreaction or sticky prices. That effect takes place even if initial anchor had no rational explanation.

Framing heuristic is observed when decision depends on the context the problem is presented for consideration. In financial investment decisions depend on information collected from stand-alone financial statements (easier in the analysis for individual investor and available in a shorter time) or consolidated statements (detailed yet more complex and requiring more efforts). Valuation Multiples depend on the selection of companies operating with a similar business model in the industry. Since there are no formal rules but only rational justification of competitors' selection it affects results of multiple evaluation. Simplicity of multiples method is fraught with risk of incorrect selection of perspective, because all that might seem to be even a little reasonable for investor is considered rational.

Following heuristic of representativeness while making decision we refer to a similar problems recognized in the past or we succumb to stereotypes. Therefore, it happens that investors are willing to acquire assets at unreal higher and higher prices that are observed in series of daily quotations and thus contribute to an even greater speculative price increases. Therefore, we can say that investors have a tendency to overestimate the near past events and ignore long-term observations. Following representativeness leads often to myopia in assessment.

The behavioral finance approach starts to play a significant role in practice of financial investment and is adopted and developed even by the most famous investors like George Soros who's strategy is well recognized as investing in value. He believes in two-way feedback relationship between perception and reality which supports the growth of self-reinforcing and ultimately self-decaying wave of market growth. Moreover, he argues that every market bubble is a complex of trend and misperceptions remaining in interaction with each other. G. Soros first of all noted that traditional economic theories are wrong because they assumed that humans behaved rationally and had access to complete information so that the quality of decision-making depended on knowledge. However, in his view of the Theory

of Reflexity humans' behaviors are guided by two interrelated components: the cognitive function and the manipulative function. In this case, the reflexity means that market expectations depend on perception of the situation while the situation itself is – among others – under the influence of market participants' expectations.

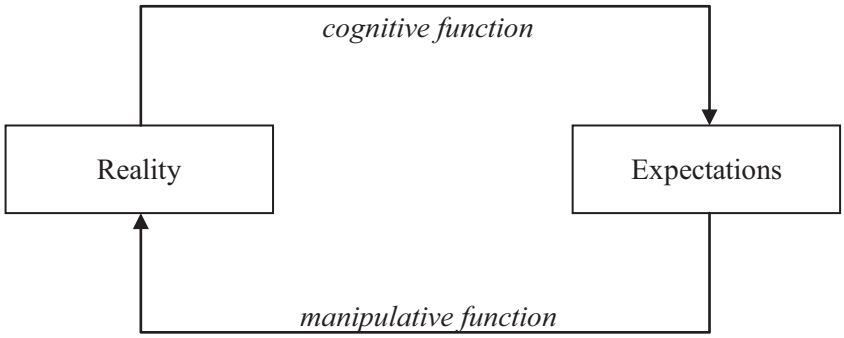


Fig. 1. The idea of George Soros' concept of the reflexivity

The theory applies exclusively to situations that have thinking participants. The participants' thinking serves two functions. One is to understand the world in which they live (the cognitive function). The other is to change the situation to one's advantage (the participating or manipulative function). The two functions connect thinking and reality in opposite directions. In the cognitive function, reality is supposed to determine the participants' views. The direction of causation is from the world to the mind. By contrast, in the manipulative function, the direction of causation is from the mind to the world, that is, the intentions of the participants have an effect on the world. When both functions operate at the same time they can interfere with each other. It means that humans change the situation at the moment they recognize it and make decisions upon the perception. The concept of reflexivity assumes that humans are imperfect in recognizing and evaluating information they perceive. Even if information is impartial itself its perception is subjective and there are as many subjective points of view as many market participants especially when if they don't follow some general formal restrictions or procedures. Cumulated subjective yet similar expectations move away from a rational justification if myopic individual investors are prevailing group of market participants. It is generally recognized that the complexity of the financial markets exceeds our capacity to comprehend it. The main source of difficulties is that participants are part of the situation they have to deal with. Confronted by a reality of extreme complexity we are obliged to resort to various methods of simplification – generalizations, dichotomies, metaphors, decision-rules, moral precepts, etc. These mental constructs take on an existence of their own, further complicating the situation.

Related Research

Empirical researches of investors' activities at the stock market highlight some specific behaviors of individual investors that can affect their portfolios performance. Numerous researches show inclination to follow heuristic thinking and cognitive or emotional biases when investing. The main areas of irrational behavior concern stochastic of price changes, pricing securities, portfolio management strategies and transaction practice (De Bondt 1998). Most individual investors follow a trend. The research provided among American Association of Individual Investors members show that 1% growth of stock market index in a

week increases the difference between investors expecting index to continue rising the following week and investors expecting index to fall. Moreover, investors sentiment depends on market performance in previous 100 days (De Bondt 1993) and trend or risk extrapolation for most of investors is only intuitive and naive (Andreassen 1988). Bull market makes investor more bullish, while bear market makes them more bearish.

Similar intuitive processes are observed in capital assets pricing. Only a few individual investors use formal pricing models, while a common practice is using informal information from other investors or financial advisors that may cause availability and anchoring heuristics. Individuals consider as the best investment stocks that recently grew sharply or are highlighted in media (Shiller 1990). They chose also overvalued companies with high price to book value ratio. Most of the individual investors do not use formal strategy rules and most of their decisions are random and often is not planned. Even if formal strategy exists it is being commonly broken (Shefrin i Statman 1997) and average individual investor portfolio is usually weakly diversified (Shefrin 2001, Benartzi and Thaler 2005).

The combination of situational and individual approaches to risk propensity through consideration of individual responses to different risk domains is another interesting and promising stream of research. The work of Weber and Milliman (1997), and subsequent work by Weber et al. (2002) represents an important development in this field. Authors found that while the degree of risk perceived in a situation could vary according to the characteristics of the situation, attitude to perceived risk (the degree to which people find perceived risk attractive) remained stable across situations for a significant portion of their sample. Work in this area (Fagley and Miller, 1997; Weber and Milliman 1997) shows that it is possible to be risk seeking in some areas of one's life and risk averse in others while having a relatively consistent view of risk.

M. Kaustia and S. Knupfer proved that there was a dependence between previous IPO success in Finland and the interest in participating another initial offer. That is an obvious evidence of mental accounting heuristic known as *house-money effect*. Authors stress that although there are still a few empirical evidences of how investors acquire knowledge and capture experience it was discovered that experienced investors usually fall in less behavioral traps than inexperienced stock market beginners (Kaustia and Knupfer 2008).

G. Chen, K.A. Kim, J.R. Nofsinger and O.M. Rui analyzing data provided by Chinese brokerage companies found quite a low effectiveness of Chinese investors' decisions. Authors prove that investors followed three basic heuristics: disposition effect, overconfidence and representativeness. Moreover, effects of disposition and overconfidence were stronger than compared to American investors and experienced investors were as susceptible to follow heuristics as beginners (Chen et al. 2007).

W.B. Elliott, F.D. Hodge and K.E. Jackson examined how individual investors' experience may influence not only on portfolio management techniques but also the way information are analyzed and processed. On one hand they proved that experience in financial investment has positive effect on portfolio returns but it wasn't clear if it influences relationship between the set of information considered as important and portfolio performance. Authors noticed that methods of obtaining, analyzing and integrating information differs with professional and individual investors (Elliot et al. 2008).

Finally, research provided by T.L. Liao analyzing 36 investment strategies at Taipei and Shanghai stock exchanges proved that market overreactiveness is a feature markets with shorter history. The younger the market the lower risk of publishing unexpected negative information and in consequence the more emotional is investors' reaction as well as market volatility. On the other hand, market development covering at least few cycles of economy experiences investors and causes that level of overreactiveness is significantly lower (Liao 2002).

Experienced and Inexperienced Individual Investors in Poland – Evidence from a Survey

Regarding existing differences in behavior of experienced investors and beginners CATI survey was conducted on Polish investors to discover if investment practical experience is correlated with stock market risk perception and tools that investors use to evaluate securities' value. These studies extend the state of knowledge regarding mechanisms of stock exchange, efficiency and rationality of decisions of market participants.

A total of 202 survey's observations registered from 25 August 2008 to 24 June 2010 were analyzed. Out of all observations, 66 were answers by respondents declaring themselves as investors, while 136 left by respondents inexperienced in investing. Both groups of respondents answered identical (in meaning) questions (see Table 1) although literary different as both had a different perspective of their own activities at a stock market (past and possible future). Respondents were asked to indicate on 6-point scale if and how strongly they agree (6 to 4) or disagree (3 to 1) with presented situations or did (would) they act as described in question. Answers from experienced in investing respondents regarded assessment of their own behaviors and attitudes. In case of inexperienced ones they assessed they were asked to imagine how they would behave as stock market investors if there were ones in the future. Confronting answers of both groups identified changes in attitudes and behaviors that appear when beginners become investors. The analyses of similarity in distribution of answers from all selected groups were provided with three standardized to [0;1] scale measures: Clark's coefficient of divergence (Clark 1952), Matusita distance measure (Matsusita 1955) and Walesiak's distance measure (Walesiak 1999).

Table 1. Survey questions on risk and investment analysis – experienced investors and inexperienced respondents

Code	Questionnaire for experienced investors	Questionnaire for inexperienced respondents
Q1	*All shares are the same risky.*	*All shares are the same risky.*
Q2	*I don't use a formal measure of investment risk. I sense it using intuition.*	*I wouldn't use a formal measure of investment risk. I would sense it using intuition.*

Code	Questionnaire for experienced investors	Questionnaire for inexperienced respondents
Q3	*Technical analysis (charts, patterns, trends, indicators etc.) is the best tool to forecast price movements and select assets.*	*Technical analysis (charts, patterns, trends, indicators etc.) would be the best tool to forecast price movements and select assets if I were an investor.*
Q4	*Fundamental analysis (financial results, macroeconomic data and events etc.) is the best tool to forecast price movements and select assets.*	*Fundamental analysis (financial results, macroeconomic data and events etc.) is the best tool to forecast price movements and select assets if I were an investor.*
Q5	*I rely on correlations selecting assets to my portfolio.*	*I would rely on correlations selecting assets to my portfolio.*

Distribution of answers are presented below (see Fig. 2 and Table 2). First of all attention must be paid to unequal gender distribution of participants with males active at the market and females dominating group keeping away from investment. That also reflects the reality of the Polish and also European financial markets dominated by males.

Answers distribution analysis show that there are no significant differences between experienced investors and inexperienced respondents in cases of market risk perception (Q1), use of Technical Analysis (Q3) and Fundamental Analysis (Q4). 79% of inexperienced group and 87% of investors disagree with statement saying that all shares are the same risky. Only 6% of experienced and 9% of inexperienced strongly agrees. All distance measures confirm that distribution of answers is similar. There are no statistically important (p=0,05) differences between answers of males and females of both groups although Clark's divergence suggests they differ. It is supposed that is only because of a low quota of experienced females participating the survey.

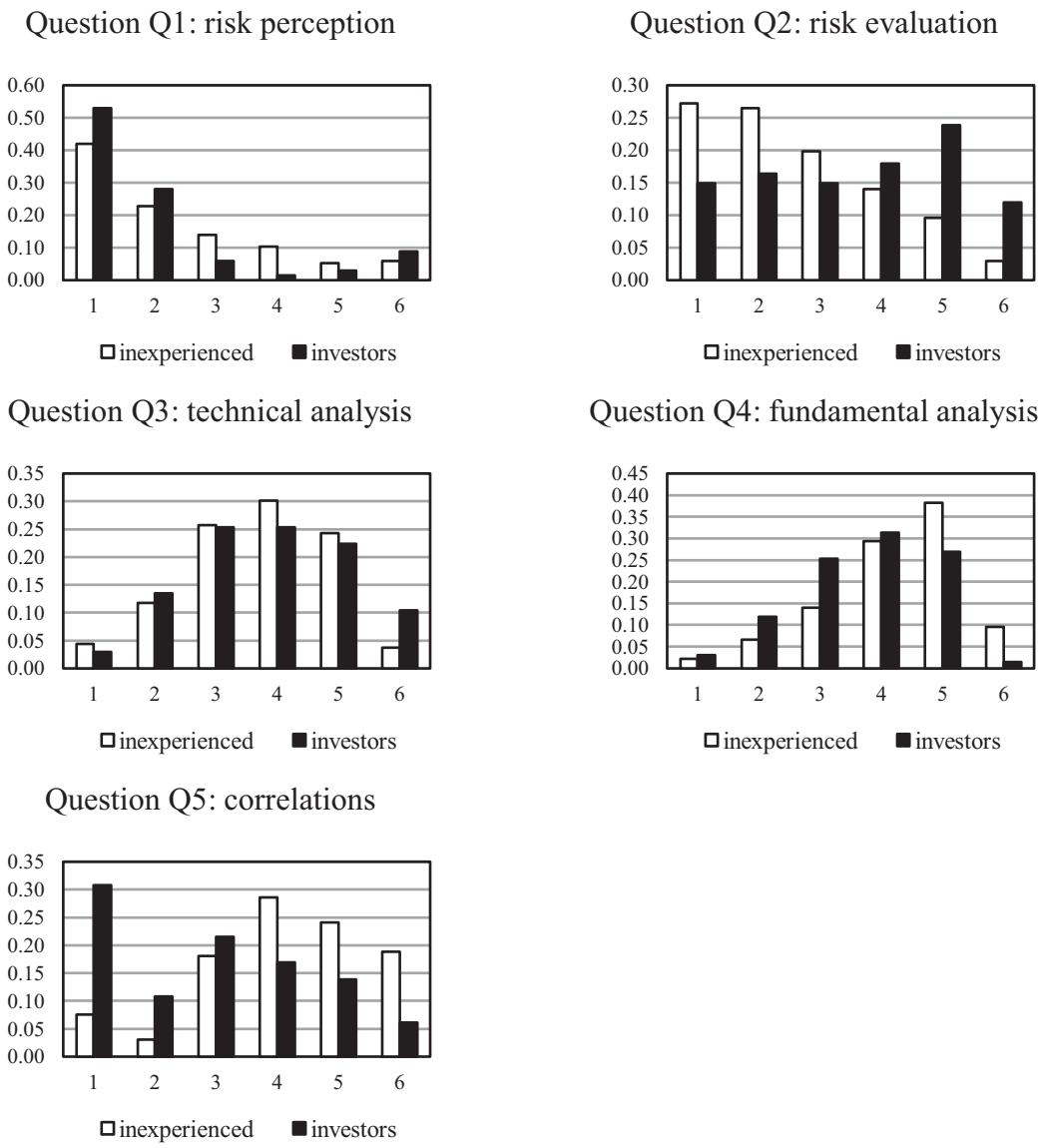


Fig 2. Distribution of answers – investors and inexperienced respondents

Table 2. Respondents' groups and their average notes

Group	N	Q1	Q2	Q3	Q4	Q5
male investors	56	2,02 (1,58)	3,38 (1,56)	3,84 (1,35)	3,82 (1,10)	2,88 (1,68)
female investors	10	1,90 (1,52)	4,40 (1,96)	3,80 (1,14)	3,00 (1,05)	2,70 (1,70)
inexperienced males	52	2,17 (1,63)	2,35 (1,30)	3,56 (1,32)	4,27 (1,12)	4,21 (1,49)
inexperienced females	84	2,35 (1,44)	2,75 (1,50)	3,75 (1,17)	4,15 (1,26)	3,90 (1,59)
Total	202	2,21 (1,53)	2,92 (1,56)	3,73 (1,23)	4,06 (1,17)	3,74 (1,59)

Similar findings are provided when interest in Technical Analysis declared by both groups is taken into account. In that case respondents are even more consistent: 58% of each groups believes that Technical Analysis is or can be a useful tool in stock market investment and 10% of experienced investors and 4% of the remaining group agrees with that sentence unconditionally. Answers suggest that Technical Analysis will be applied more often if investor is better experienced. In that case no important distinctions were found when investor's gender was considered.

Fundamental Analysis application as investment tool distinguish respondents. Average answers of both groups show that. It seems that investment practice verifies beliefs of beginners that stock market forecasts situation in the economy, financial results and macroeconomic data are simply reflected in security prices. Beginners becoming investors are faced with failure: Fundamental Analysis is more difficult than expected and if semi-strong or strong EMH is true it may be useless. Measures of similarity show that along with gaining experiences difference between males and females attitudes may appear: experienced men are more likely to use Fundamental Analysis.

Experienced and inexperienced investors distinct most in declarations of using correlation as one of investment tools. Correlation indicates that investor is familiar with portfolio theory and diversification. The high percentage of positive declarations of inexperienced investors (71% would use it and 19% always) is not surprising. Positive answer in this case may be considered as protecting self-esteem. Even if portfolio theory is known to inexperienced individuals most of them definitely don't know how to use correlation and how labor-intensive is using the theory in practice in that case. What is not surprising then is the fact that only one out of three experienced investors admits the use of correlation in practice and only 6% does it always or almost always.

The most interesting part of results was found when investment risk measurement was considered. Rising experience in investment causes investors to follow intuition in risk assessment. 74% of beginners and respondents without experience declared that they would measure investment risk in some way. Practitioners don't use measures but rather sense risk.

That is opinion of 54% of that group and in 12% it happens always or almost always. In comparison only 3% of beginners agree with that. Intuitive investing seems to be a common practice of individual investors.

HEURISTIC VALUATION – FROM DISCOUNTED CASH FLOWS TO MULTIPLES

Methods of using multiples as well as discounted cash flows to estimate fair value of stocks are widely documented in both literature and practice of the financial markets. For institutional investors or investment recommendations they are common performing evaluative functions, being a subject of negotiations in M&A transactions and rational reference being in line with formal investment strategy. The use of both methods at the same time is justified as they may present different values due to different underlying factors and procedures of valuation.

DCF valuation has the most solid fundaments in theory of finance and furthermore all other methods of valuation originate from the analysis of discounted cash flows. The advantage in the use of DCF valuation comes from the fact that it is the only method by which it is possible to estimate economic value of the company only based on potential cash flows that are expected to appear in a long term and by this it forces long term forecasting of all investment ventures. At the same time a long perspective of forecasts incorporates quite a huge level of risk that forecasts are incorrect. Moreover, often a large part of the value is accounted as residual value that is sensitive to changes of parameters.

Multiples should be considered as a supplement of DCF valuation and represents a relative value that should be achieved by security if all important factors (Earnings, Book Value, EBIT, EBITDA or other) were incorporated in its price to the extend the market does it with competitors with a similar business model. Reflecting current sentiment of the market is its biggest advantage of this method as well as ease in calculate even by individual investors. Selection of comparable public listed competitors may be a serious problem though. It may be impossible to achieve especially at the very stage of market development when cross-country comparison is not justified. The method doesn't include different profiles of risk and growth rate of company and its current value is estimated basing only on history or short term forecast. Nevertheless this is most common procedure of simple valuation.

In mergers and acquisitions (M&A), sellers and buyers normally base their price calculations on multiples of EBITDA, a figure often used by investors to analyze a company's value. EBITDA is extremely important in M&A transactions, and especially so for the determination of the purchase price. However, like all other estimation tools, EBITDA has inherent limitations and dangers (Kicia 2009).

The term is not formally defined by general accounting standards. While the theory behind multiples based on EBITDA may be sound, in practice reliance on these by sellers and buyers alike is often quite flawed. Additionally, the use of EBITDA in estimating value in small or family-owned business transactions creates difficulties in the negotiation process because of the limited availability and quality of financial statement information.

EBITDA is used in M&A transactions, in both binding and non-binding offers, in order to determine the purchase price that will be paid. In non-binding offers the use of EBITDA does not present a problem since the purchase price included is not enforceable against the parties in an eventual disagreement. However, in binding offers, EBITDA can be problematic for either side of the transaction when the EBITDA of the company is higher or lower than expected.

EBITDA forecasts is also one of the crucial parameters in DCF valuation as discounted cash-flows usually begin in healthy and profitable operating results. The aforementioned disadvantage of DCF valuation for all investors is its sensitivity to assumptions and forecasts. If DCF value is calculated on 20 years of forecast what is the quality of that forecast? Are we really able to estimate them correctly and if not maybe we should simplify the method and limit forecast up to forthcoming 2-3 years followed by estimated residual value. This approach would be promising for individual investors that are unable to discover future of valued companies due to lack of time, asymmetric information and computational problems.

Let us assume that we need a method that takes into consideration also behavioral nature of individual investors:

1. Representativeness and availability: investors predict next quarter results depending on information that is provided in last four quarterly financial statements. Their predictions cover revenues, EBIT and EBITDA profitability, rotation cycles of inventories, short-term receivables and current liabilities.
2. Myopia: investors are not able to provide a long term prediction. Instead of that they can simply incorporate a growth rate of revenues observed by comparing last four quarters (from Q_{-1} to Q_{-4}) to preceding four quarters (from Q_{-2} to Q_{-5}) and with stable EBIT profitability.
3. Framing: investors estimate company (share) fair value depending on stand-alone financial statements (usually announced earlier) or consolidated financial statements (usually announced later). Anchoring may appear when investors stick to values obtained from stand-alone statements even if consolidated statement is announced.
4. Investors need a simple method of estimating residual value of the company as they understand that a short term forecast is not enough to justify its value. The residual value can be obtained by a simple multiple of the last observed cash-flow or balance sheet values.
5. Risk free rate is observed as government debt YTM and credit risk margin at market level for similar companies.
6. All public companies are traded with the same beta equal to 1 as investors are not able to calculate their proper value. As a matter of fact in 90% of market reports and recommendations in Poland beta equal to 1 is assumed.
7. Investors are not able to estimate CAPEX and depreciation correctly without detailed information from the valued company so they assume that when CAPEX is done it will appear in company profitability or growth of revenues. Assuming CAPEX equal to depreciation simplifies procedure as in residual period.
8. Residual cash flows growth rate (g) is 0%.
9. Non-operating assets are equal to long-term investment assets and net debt is calculated depending on values observed in last announced financial statement (anchoring).

Assuming the above three alternative models of equity value were tested:

Model I. DCF proxy with simplified assumptions but still most complex calculations

$$EV_{QT} = \sum_{i=1}^{3} \frac{FCF_{QT-1} \cdot (1+er)}{(1+WACC)^i} + RV_{QT} + NOA_{QT-1} - ND_{QT-1}$$
$$RV_{QT} = \begin{cases} \dfrac{FCF_{QT-1} \cdot (1+er)}{(1+WACC)^3 \cdot WACC}, if\ FCF_{QT-1} > 0 \\ 0{,}99 \cdot RV_{QT-1} + 0{,}01 \cdot \dfrac{FCF_{QT-1} \cdot (1+er)}{(1+WACC)^3 \cdot WACC}, if\ FCF_{QT-1} \leq 0 \end{cases} \quad (1)$$

where:

EV_{QT} – equity value forecasted for quarter T
RV_{QT} – residual value forecasted for quarter T
FCF_{QT-1} – free cash flow of the last quarter
er – expected FCF growth rate (respecting assumption 2)
WACC – Waged Average Cost of Capital as in DCF (respecting assumptions 5-6)
NOA_{QT-1} – Non-Operating Assets as in statement for quarter T-1
ND_{QT-1} – Net debt as in statement for quarter T-1

Model II. DCF proxy with simplified calculation of residual value

$$EV_{QT} = \sum_{i=1}^{3} \frac{FCF_{QT-1} \cdot (1+er)}{(1+WACC)^i} + RV_{QT}$$
$$RV_{QT} = \begin{cases} TFA_{QT-1} + CA_{QT-1} - LR_{QT-1}, if\ FCF_{QT-1} > 0 \\ 0{,}99 \cdot RV_{QT-1} + 0{,}01 \cdot \left(TFA_{QT-1} + CA_{QT-1} - LR_{QT-1}\right), if\ FCF_{QT-1} \leq 0 \end{cases} \quad (2)$$

where:

EV_{QT} – equity value forecasted for quarter T
RV_{QT} – residual value forecasted for quarter T
FCF_{QT-1} – free cash flow of the last quarter
er – expected FCF growth rate (respecting assumption 2)
TFA_{QT-1} – Tangible Fixed Assets for quarter T-1
CA_{QT-1} – Current Assets for quarter T-1
LR_{QT-1} – Liabilities and Reserves for quarter T-1
WACC – Waged Average Cost of Capital as in DCF (respecting assumptions 5-6)
NOA_{QT-1} – Non-Operating Assets as in statement for quarter T-1
ND_{QT-1} – Net debt as in statement for quarter T-1

Model III. EBITDA x10 multiple

$$EV_{QT} = max\{0; 10 \cdot EBITDA_{QT-1} + NOA_{QT-1} - ND_{QT-1}\} \quad (3)$$

where:

EV_{QT} – equity value forecasted for quarter T
$EBITDA_{QT-1}$ – EBITDA value observed for quarter T-1
NOA_{QT-1} – Non-Operating Assets as in statement for quarter T-1
ND_{QT-1} – Net debt as in statement for quarter T-1

All proposed above heuristic valuation models were tested for improvement of potential investment results of hypothetical individual investors. First, for all but financial companies listed at The Warsaw Stock Exchange main market valuation procedures were applied for all available quarters. Financial data for the sample of 415 companies listed in 2000-2012 was provided by Notoria Service. Out of all valued companies for the next step were qualified only these with at least 12 quarterly valuations (reference fundamental values according to Model I, II and III separately for at least 3 years). For all periods with reference values of all selected companies 500 hypothetical transaction (open and close dates) were randomized and annual return for each transaction was calculated. The average annual return and standard deviation represented a distribution of possible returns for investors without fundamental reference value.

The same procedure was repeated but another 500 transactions were filtered by values provided by tested models for the date of transaction. That said if market price was higher than a heuristic fair value the company was recognized as overvalued and hypothetical investor cancelled buying. The average annual return and standard deviation represented a distribution of possible returns for investors with fundamental reference value provided by Model I, II and III respectively.

Comparing results of both samples for all companies it was analyzed if investors using heuristic models can improve their results of random investing. The same procedures were provided using stand-alone and consolidated financial statements.

RESULTS AND DISCUSSION

Results of experiments (see Table 3) indicate that the use of proposed valuation methods wouldn't have an unequivocal impact on investment strategy. With rather low average improvements of annual returns (from 5,2% to 10,5%) for about a half of all analyzed companies (from 43% to almost 56%) it rather confirms at least semi-strong EMH of Polish stock market in 2000-2012.

Table 3. The results of testing procedures

Test number	I	II	III
	IV	V	VI
Financial statements	stand-alone	stand-alone	stand-alone
	consolidated	consolidated	consolidated
Initial sample of companies	415	415	415
	415	415	415
Applied model of valuation	I	II	III
	I	II	III
Companies qualified for step II	288	178	181
	238	226	172
Companies with improved results using model	52,0%	50,0%	43,0%
	54,2%	55,6%	44,9%
Average increase of returns (standard deviation)	5,3% (6,0%)	5,2% (5,1%)	8,5% (14,6%)
	10,3% (14,2%)	5,8% (6,5%)	7,2% (6,5%)
Average decrease of returns (standard deviation)	-9,5% (14,2%)	-7,2% (7,1%)	-15,2% (19,1%)
	-8,6% (13,8%)	-7,7% (12,8%)	-13,3% (19,0%)
No. of stocks with increased results (difference in returns statistically significant, α=0,05)	20	7	10
	24	10	11
Average increase of returns with statistically significant improvement	15,4%	11,3%	20,2%
	28,3%	15,5%	14,7%
No. of stocks with decreased results (difference in returns statistically significant, α=0,05)	33	7	31
	23	11	22
Average increase of returns with statistically significant improvement	-26,6%	-14,1%	-32,8%
	-23,0%	-26,5%	-27,5%

Experiments show that it is possible to improve results with additional information on fair price levels but if we consider individual investors with random strategy of selection securities over the analyzed period valuation will not separate stocks to exact winners and

losers. Almost the same number of investors would improve their portfolio results as those who face downgrading their effectiveness. Possible average decrease in average return is in almost all cases higher than average increase for opposite securities. The one case is experiment IV with Model I and the use of financial information from consolidated statements.

In general, all the results indicate that simplifying valuation in a proposed methods may provide better results the less simplification if provided into the procedure of valuation based on discounted cash flows. The more it is consistent with complex DCF the better market tracking it may provide as better net results were provided by Model I on consolidated statements than most simplified multiple-based Model III. This result is not surprising if we mind that individual investors usually are not the group influencing market prices due to their capital dispersion. They could impact market prices in a long time if a large enough group of individuals would behave in the same way or would use the same analytical tools suggesting buying or selling at almost the same moment. Herding effects that appear in that circumstances could cause waves of growth or decline to the market. Shallow markets with rather low turnover, illiquidity and lack of rational investors may be a good example confirming that it is easier to manipulate prices. At the developed markets reality is different. Institutional investors both domestic and foreign with large capital allocated to the market induce trends or cease them and while fair price is defined by formal methods of valuation they may vary in assumptions of forecasts but usually represent comparable level of value. Individuals with their beliefs and intuitions have no other choice but accept market level even if they were sure their method of simplified valuation as well as forecasts were correct. Extra returns are consequence of timing and quality of forecasts than methods of incorporating them into prices established by the market.

Although presented results of experiments do not seem optimistic for individual investors and their strategies for the market are satisfactory. Among others they confirm that the Polish stock market is effective in at least semi-strong level of EMH as other most developed markets.

REFERENCES

1. Andreassen P. B. (1988), “Explaining the price-volume relationship: The difference between price changes and changing prices”, *Organizational Behavior and Human Decision Processes*, Vol. 41, 371-389.
2. Benartzi S., Thaler R. (2005), “Naive Diversification Strategies in Defined Contribution Savings Plans”, [in:] R. Thaler (ed.), *Advances in Behavioral Finance*, vol. II, Princeton University Press.
3. Clark P.J. (1952): “An Extension of the Coefficient of Divergence for Use with Multiple Characters”, *Copeia*, No. 2.
4. De Bondt W. F. M. (1993), “Betting on trends: Intuitive forecasts of financial risk and return”, *International Journal of Forecasting*, Vol. 9, 355-371.
5. De Bondt W. F. M. (1998), “A portrait of the individual investor”, *European Economic Revew*, Vol. 42, 831-844.
6. Elliott W.B., Hodge F.D. i Jackson K.E. (2008), “The Association between Nonprofessional Investors’ Information Choices and Their Portfolio Returns: The

Importance of Investing Experience", *Contemporary Accounting Research*, vol. 25 no. 2, 473-498.
7. Foucault T., Sraer D., Thesmar D.J. (2011), "Individual Investors and Volatility", *The Journal of Finance*, Volume 66, Issue 4, 1369–1406.
8. G. Chen, K.A. Kim, J.R. Nofsinger i O.M. Rui (2007), "Trading Performance, Disposition Effect, Overconfidence, Representativeness Bias, and Experience of Emerging Market Investors", *Journal of Behavioral Decision Making*, vol. 20, 425-451.
9. Kaustia M., Knupfer S. (2008), "Do Investors Overweight Personal Experience? Evidence form IPO Subscriptions", *The Journal of Finance*, vol. LXIII, No. 6, 2679-2702.
10. Kicia M. (2009): "Stock Market Behavioral Agent-Based Modeling", *Proceedings of 2009 International Conference on Technology Innovation and Industrial Management*, Thailand, 15-26 (Section S4).
11. Liao T.L. (2002), "Can a Calm Investor Attitude Be Obtained Through Experience and Learning?", *The International Journal of Finance*, Vol. 14 No. 4, s. 2388-2397.
12. Matsusita, K. (1955), "Decision rules based on distance for problems of fit, two samples and estimation", *Annals of Mathematical Statistics*, Vol. 26, 631-641.
13. Shefrin H., Statman M. (1997), "Comparing expectations about stock returns to realized returns", Working paper, Leavey School of Business, Santa Clara University, February.
14. Shefrin H. (2001), *Behavioral Finance*, vol. III, An Elgar Reference Collection.
15. Shefrin H. (2005), *A Behavioral Approach to Asset Pricing*, Elsevier Academic Press.
16. Shiller R. J., (1990), "Speculative prices and popular models", *Journal of Economic Perspectives*, Vol. 4, 55-65.
17. Sławiński A. (2006), *Rynki finansowe*, Polskie Wydawnictwo Ekonomiczne, Warszawa.
18. Walesiak M. (1999), "Distance Measure for Ordinal Data", *Argumenta Oeconomica*, Wrocław University of Economics, No. 2 (8), 167-173.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

INFLUENCE OF GLOBALIZATION AND INTEGRATION PROCESSES ON ACCOUNTING REGULATIONS ON THE EXAMPLE OF POLAND

Małgorzata Kamieniecka, Department of Accounting, Faculty of Economics, Maria Curie-Sklodowska University in Lublin, Poland
malgorzata.kamieniecka@poczta.umcs.lublin.pl

ABSTRACT

Purpose: *The growing internationalization of the economies of individual countries, imposes on the national regulators the processes of harmonization and standardization in the accounting rules. The last 20-30 years, we have witnessed significant transformation of financial reporting of companies (changing forms of presentation and content of the reports). These changes result from the transformation of national economies caused by: 1) internal processes (change of ownership, the appearance of new legal forms of business and new financial instruments, changes in management methods, etc.), 2) external processes (increasing globalization and integration). This second group of factors is particularly important in countries such as Poland, which, in a relatively short period of time, restructured its economic system from state-controlled economy to a market economy, at the same time, intensively joined the European integration, thus implementing a number of regulations applied by the EU. The purpose of this paper is to determine the effect of changes in accounting regulations caused by the processes of globalization and integration (mainly European) on a national accounting model.*
Conclusions and findings: *The processes of globalization and integration have a significant impact on changes in national accounting models. These changes are intended to ensure the comparability of the effectiveness of the companies in transnational scale. The most important influence on the financial reporting in Poland, during the system transformation, had the EU Directive, and in the last 10 years - IFRS. However, it should be noted, that at this stage of development, it is not yet possible to fully standardize financial reporting, even in countries belonging to the same economic and cultural region of the world.*
Practical implication: *The structured knowledge about the experience in the implementation of international practices and regulations of the accounting of given country makes it easier to predict the possible reaction of business practice and legislation changes in the future (will allow predict the speed and depth of changes and the level of acceptance and perception of new reporting requirements, both by preparing reports, as well as the users of these reports). This knowledge is particularly important for policy makers and regulators because will allow them to plan properly the process of legislative changes.*
Design/methodology/approach: *The research methodology will include an analysis of the foreign and Polish literature on the subject, the review of polish, EU and worldwide accounting regulations, the inductive and deductive methods. The inductive method should prove useful in analysing the literature and law. The main conclusions will be drawn using scenario of deductive methods.*
Originality/value: *A number of scholarly articles on the changes in Polish accounting regulations in the last 20-25 years were published so far. However, they lack a clear indication of the relationship of these changes to the global processes of globalization and European integration. This article is an attempt to fill this gap.*

INTRODUCTION

The expectations of both external and internal financial information recipients have been growing, along with progressing globalisation. This forces accounting regulations to provide for universal presentations of data coming from financial statements. Harmonisation leading to higher comparability, followed by standardisation reflected in consolidated principles of identifying, measuring and reporting property and resultant items, have become common. Such processes are triggered by globalisation-induced capital-market integration around the world, and by the opening of domestic markets to foreign-investment companies, together with the simultaneous expansion of domestic entities beyond their country of origin.

Both individual investors and public institutions, including supervisory bodies, are more likely to appreciate the benefits flowing from commonly-known and universally-recognised financial-reporting frameworks, based on strong and globally-accepted accounting standards. These benefits include, in particular, better data comparability, higher willingness and better opportunities to invest abroad, more efficient asset allocation, lower capital costs, and higher dynamics of economic growth.

This article is aimed at determining the impact of changes to accounting regulations caused by globalisation and integration processes (mainly in Europe), on the domestic-accounting model. The analysis of changes to balance-sheet law partly covers the factors resulting from the systemic transitions which occurred in the Polish economy. The reporting entities' reaction to the amendments to Polish balance sheet law will also be examined.

The methodology of this study comprises an analysis of both foreign and Polish literature on the subject matter, a survey of Polish, European and global accounting provisions, and an outline of various studies on related issues.

Polish accounting prior to the systemic transitions

Prior to the Second World War, Polish accounting was governed by the Commercial Code of 1934, which merely laid down some general report-drafting principles to be followed by economic units (CC, 1934). It is argued that accounting at that time mainly served fiscal purposes (Foremna-Pilarska and Radawiecka, 2007).

The German occupation during the Second World War had a considerable influence on Polish accounting. This was when it acquired the continental features which are still to be observed. The first Uniform System of Accounts, which entered into force on 1 January 1946, was also based on German solutions (and, more specifically, on the German system of accounts and on its equivalent – the system of accounts of the General Government). The Uniform System of Accounts not only contributed to consolidating numerical data in the overall economy but also facilitated, through its flexible approach, adjustments to the specificity of a given sector or entity (at this point, the considerable freedom of costs measurement and reporting should be noted) (Jaruga and Szychta, 1997).

A few years after the War, Poland accepted the accounting solutions applied in the Soviet Union. Accounting was at that time oriented towards satisfying the needs of government planners, performing mainly control functions. The content and methods applied in the

accounting system were specified in more detail within the legal regulations. Together with the diversification of various economic divisions, in 1950 the Uniform System of Accounts was replaced by the Industrial System of accounts. This marked the end of the flexible approach, which was reflected by a detailed specification of the correspondence in accounting (apart from the economic content).Then introduction of the framework system of accounts in 1952, entirely based on Soviet solutions (entailing opting out of the use of the structure of costs by type and the overextended system of accounts) turned out to be the most disadvantageous change. Furthermore, the duplicated accounting technique was replaced by registered accounting (Biadacz, 2012).

Since around 1960, Polish solutions have prevailed over the Soviet ones. In 1959, a new system of accounts for socialised economic entities was introduced (which then provided the basis for establishing industrial systems, regarded as typical). Its form resembles Western European solutions, while its content was tailored to the needs of a centrally-steered economy. Another reform, dating back to 1976, facilitated aggregating reporting data countrywide by various sectors, including industries, branches, and divisions or fields of the national economy. According to the author of this study, this reform could serve as a concrete example of setting the contemporary directions of changes related to registering obligations. The first economic reforms at the outset of the 1980's (referred to as the thawing period) marked another turning point by introducing the possibility of using personalised in-house accounting systems (Jaruga and Szychta, 1997).

The reference period, from the point of view of this study, can be briefly characterised as the period of transitions in Polish accounting, caused firstly by German, and then by Soviet, influences.

Polish accounting regulations in the transition period towards a market economy

The beginning of the 1990's in Poland brought significant changes to economic entities, resulting from systemic and economic transformations. The shaping of free-market economy and the openness towards international cooperation forced the reconstruction of accounting paradigms. Amendments to balance-sheet law had to be profound, and their pace adjusted to political and economic developments. It had to be fast enough to foster these developments and, at the same time, properly timed to let the units concerned pursue preparatory processes related to IT systems and staff training. However, it should be noted that balance-sheet reform was facilitated by the relatively strong position of accounting theorists who had established contacts with global experts. Moreover, certain sections of general accounting theory (e.g. evidence-modelling theory and the deductive theory of the systems of accounts) were highly innovative, providing a valuable contribution to global expertise at that time (Brzezin, 1995).

At the outset of the transformation period, substantial changes were introduced to accounting legislation. The Regulation of the Minister of Finance (of 15 January 1991) on the rules of book-keeping entered into force as of 1 January 1991. It was the first Polish Act of law entirely devoted to accounting, separating it (not yet fully but to a large extent) from fiscal law. In line with the idea to strengthen the country's integration with Western European countries, this Act was based on the Fourth Directive of the EEC (today the EU). Poland established a diplomatic relationship with the European Economic Community in September

1989 (although until 1989 it had belonged to the Council for Mutual Economic Assistance, competitive with the EEC), and the agreement between Poland and the EEC was signed on 19 September 1989. Therefore, the amendments to balance-sheet law resulted, to a large extent, from political and economic decisions aimed at associating with Eastern European countries. Nevertheless, according to the author, these were internal processes that exerted a more important influence on the amendments to balance-sheet law at that time, including the fundamental property transitions to foster private-sector growth[1], the liquidation of monopoly structures, the price liberation and the activation of the capital market. The newly-introduced regulation governed such issues as the principles of book-keeping, stock-taking, the determination of the financial result, the principles of assets and liabilities valuation, accounting evidence and reporting. A uniform structure for the balance sheet, and the profit-and-loss account was established (The Regulation of 1991).

The reference Regulation was in line with the strategy of establishing an appropriate institutional and legal framework conductive to systemic transitions and, according to the author, it served its function exceptionally, paving the way for modern corporate reporting.

Nevertheless, as the Regulation failed to touch upon several crucial aspects of the economy (e.g. leasing, the consolidation of financial statements and the principles of drafting cash-flow statements), a number of issues remained under-regulated, and for some others alternative solutions were used. As a result, efforts were made to draft a new Act of law that would regulate accounting in a more thorough way. On 1 January 1995, the Accounting Act of 29 September 1994 came into force. Among the significant objectives that were adopted (which included determining, consolidating and stabilising the conditions to be complied with by accounting, ensuring the uniformity and transparency of accounting solutions, strengthening the position of accounting in line with the function it serves in the modern economy, and laying the ground for the provision of reliable and more detailed information for accounting purposes, useful in assessing the economic standing of various enterprises and institutions), the following are worth noting (Foremna-Pilarska and Radawiecka, 2007):

- further adjustments of Polish accounting solutions to the principles binding in EU countries (which proved especially important in the light of signing the Association Agreement with the European Community in December 1991, which entered into force on 1 February 1994, followed by an official application for the EU membership submitted by Poland in April 1994),
- attempts to adjust Polish accounting principles to the principles laid down in the International Accounting Standards (IAS) provided that:
  - they did not violate EU directives,
  - the application of international standards was feasible, given the development stage of the Polish economy at that time (as such a significant reconstruction of the entire economic system, which entailed the transition from a centrally-steered to a free market economy, is in principle a complex and long-lasting process, which is why in the mid-1990's the Polish economy was not yet ready to absorb the complex mechanisms of the IAS),

[1] In 1989 the GDP share of the private sector amounted to less than 30% and within nearly a decade it grew to approximately 75% (Rapacki, 2005).

considering the fact that when constructing the provisions of balance-sheet law, the legislator assumed that the directives had prevailed over international standards.

The harmonisation of Polish accounting provisions with the EU and international ones, at this development stage, was extremely significant, due to allowing foreign investments in the country and due to the inflow of international capital. In 1991-1995 the average annual dynamics of the growing inflow of foreign direct investments to Poland reached approximately 130% (including the order-book investments which proved significant, though their share in various years was subject to considerable fluctuations) (Weresa, 2002).

Based on the opinion of the European Council of 1997, Poland made considerable progress in establishing balance sheet law, in terms of its harmonisation with EU directives. The highest level of compliance was reached with the Fourth Directive (dated 1978 on the annual accounts of certain types of company) and with the Seventh Directive (dated 1983 on consolidated accounts) (Misińska, 2005). It should be borne in mind that financial reporting and accounting principles at that time were also referred to in three other directives:

- The Directive of 1986 on annual accounts and the consolidated accounts of banks and other financial institutions,
- The Directive of 1989 on the financial reporting of credit and financial institutions operating in Member States,
- The Directive of 1991 on annual accounts and the consolidated accounts of insurance establishments.

When compared to other countries, Poland internalised the above directives within its own legal system in an extremely short period, acting at an express pace. The average time span for introducing accounting directives to the domestic law of EU Member States was 10 years (e.g. the introduction of the Fourth Directive took 13 years in Italy, 11 years in Spain and 8 years in Greece).

Globalisation processes and the progression of European integration vs. Polish balance sheet law

The second half of the 1990's in Poland was a period of intensive efforts towards completing the Accession Agreement and being accepted as an EU member. To this end, the Committee for European Integration was established in August 1996 (whose aims included initiating and coordination adjustment work regarding legal institutions, as well as evaluating draft versions of legal Acts in terms of their compliance with EU laws), and the National Integration Strategy was enacted in January 1997. Poland launched the negotiations with the Council of Europe on 31 March 1998, which were preceded by screening, i.e. by examining the compliance of Poland's internal laws with Community laws. The partnership negotiations ended on 13 December 2002 and the Treaty of Accession was signed on 16 April 2003. Finally, Poland's accession to the European Union was effected on 1 May 2004.A survey of laws in terms of their harmonisation with EU regulations on balance-sheet law resulted in the so-called grand revision of the Accounting Act, introduced by way of the Act of 9 November 2000 on amending the Accounting Act, which became effective on 1 January 2002. The amendments were so considerable that the standard text of this Act was published in Journal of Laws of 2002, No. 76, Item 694. A relatively long *vacatio legis* of the new provisions was

applied to prepare enterprises for the incoming changes. The amendment work was also time-consuming and took over two years.

The new Act on amendments is considered to have become a modern Act of law, being much more practical in terms of the economic life of enterprises (Gnich, 2001).

The reference Act comprises 12 chapters, which comprehensively regulate the accounting principles in Polish entities, from book-keeping and stock-taking, to the valuation of assets and determination of the financial result, the settlement of company mergers, the reporting obligations of individual entities and capital groups, the audits and announcements of financial statements, and book-keeping services. The content of the reference Act is supplemented with annexes, including financial statement templates to be used by banks, insurance companies and other entities.

It is worth noting that the revision of the Accounting Act of 2000 was, to a large extent, also connected with the need to adjust domestic provisions to international standards, which had themselves undergone substantial changes in 1994 – 1999. This was reflected, i.a., by introducing IAS-based provisions (not regulated under EU directives) regarding property investments, equity instruments, and long-term contracts and mergers. Considerable changes also affected the principles of exchange-rate settlements and deferred-tax determination, along with introducing the notion of fair value and accuracy. The matters not regulated under the reference Act are subject to the domestic standards or the IAS.

Polish accounting at the outset of the 21st Century, as compared to the last decade of the 20th Century, absorbed certain features of Anglo-Saxon accounting (until 2000 it represented the typical continental model, with the caution principle dominating the true and fair view, and with significant, if not prevailing impact of tax principles over balance sheet guidelines). The emerging changes were also reflected in the establishing of the Accounting Standards Committee (ASC) by way of the Regulation of the Ministry of Finance (The Regulation of 2001).

The ASC operates within the Ministry of Finance and is comprised of accounting experts who represent various bodies participating in the establishing of accounting regulations (i.e. the Ministry of Finance, the Ministry of the State Treasury, the National Bank of Poland, and the Polish Financial Supervision Authority) and the largest professional accounting organisations (i.e. the Accountants Association in Poland and the National Chamber of Statutory Auditors) who delegate representatives of the scientific environment and auditing companies. In accordance with Paragraph 2 of the Regulation, the scope of activity of the Committee comprises:

a) establishing new domestic accounting standards, along with surveying and updating the existing ones,
b) issuing opinions on questionable accounting issues,
c) evaluating draft versions of accounting Acts,
d) analysing and evaluating draft versions of the IAS and their amendments,
e) cooperating with international accounting standardisation organisations,
f) undertaking other actions aimed at the harmonisation and standardisation of accounting principles.

The Committee cooperates with the European Financial Reporting Advisory Group (EFRAG) within the framework of the EFRAG "Pro-active Accounting" project, as its members form part of project working groups. The Committee analyses and evaluates international documents on an ongoing basis, including draft amendments to the International Financial Reporting Standards (IFRS), regarding the issues significant to Polish IFRS-affiliated entities.

So far (i.e. until April 2013), the Committee has issued:

- seven standards, i.e. No. 1. Cash-flow statements, No. 2. Income tax, No. 3. Unfinished construction services, No. 4. The impairment of assets, No. 5 Leasing and renting, No. 6. Reserves, - current calculation of periodic costs, and conditional liabilities, and No. 7. Changes in accounting principles (policies), estimated values, error correction, events after the balance-sheet date – approach and presentation;
- four opinions, i.e. on the accounting approach to property rights arising from the certificates of origin of energy produced from renewable sources, on determining the production costs for the purpose of the balance-sheet stock valuation, on the accounting approach to greenhouse-gas emission rights, and on certain principles of book-keeping;
- one recommendation on adopting the Code of Ethics for Professional Accountants.

The standards and opinions issued by the Committee are not absolutely binding (pursuant to Article 10, Paragraph 3 of the Accounting Act., In matters not regulated under the aforesaid Act, an entity may apply domestic accounting standards by referring to accounting principles (policy)). This non-obligatoriness is being strongly criticised in the accounting world and, as such, it may be subject to change as part of the next revision.

At the time when Poland was preparing its grant revision of the accounting Act, the European Commission realised that its accounting directives had failed to fully achieve the set objective, i.e. ensuring comparability of financial statements between the various Member States (the fundamental barriers included a protracted drafting, amendment and implementation process, together with the admission of alternative solutions) (Mućko, 2009). In consequence, in 2000 the European Commission decided[2] on further accounting harmonisation EU-wide, based on international standards.[3] The fear of the wide introduction of American standards (developed by the FASB) to global economic practices served as an additional argument. It was, therefore, decided that global standardisation based on the IAS/IAFS would be a better solution, as these standards were established by the International Standards Council (formerly Commission) which is a private institution, independent (unlike the FASB) of any Government (Holban, 2011).

In order to implement the strategy, it was necessary to lay down adequate regulations allowing for the application of IAS within the Community. To this end:

- most of the binding standards were modernised or improved, and some were replaced. The revised IAS/IFRS and their interpretations were finally adopted in 2004,
- accounting directives were generalised and simplified.

[2] The document entitled *EU Financial Reporting Strategy: the way forward* was adopted in June 2000.
[3] The first sign of the possible consolidation amendment to the EU financial reporting strategy, based on international standards, appeared in 1995, which was when companies listed on European stock exchanges were allowed to present consolidated IAS-based financial statements.

The legal basis for adopting IAS/IFRS as part of the Community legislation was provided by *Regulation No. 1606/2002 of 19 July 2002 of the European Parliament and Council on the application of international accounting standards.* The principal objective of the standardisation of IFRS-based financial reporting is to achieve more efficient and cost-effective functioning of the common capital markets and, in consequence, to foster the development of the internal EU market (The Regulation of 2002, Point 12).

In accordance with the Regulation, individual IAS/IFRS are included in EU law by way of executive regulations, provided that they satisfy the comprehensibility, usefulness, reliability and comparability criteria to be satisfied by financial information which is necessary to make economic decisions and to assess the management model. Pursuant to Point 11 of the justification of the Regulation, the IFRS approval mechanism shall function efficiently and provide a forum for the debate, consideration and exchange of information on international standards between the parties concerned, including in particular the entities in charge of developing domestic accounting standards, the securities market supervisory bodies, the bank and insurance supervisory bodies, the central banks, including the ECB (The European Central Bank), the professional environment of accountants, and users and entities drafting financial statements. This mechanism should serve as a means conducive to the general understanding of the international accounting standards binding within the Community. To this end, the obligatory IAS/IFRS endorsement procedure was adopted, which comprises:

1) issuing a recommendation on accepting or rejecting a given IAS/IFRS by the EFRAG), a private organisation providing advice to the Accounting Regulatory Committee,
2) approving a given IAS/IFRS by the Accounting Regulatory Committee (ARC) operating within the European Commission,,
3) issuing an opinion by the European Parliament,
4) issuing a regulation by the EC comprising the content of the IAS/IFRS adopted, and publicising it in all official EU languages in the Official Journal of the European Communities.

As shown above, IAS/IFRS adoption and interpretation within the EU legislation are not automatic and require a number of facilities. This sometimes leads to a considerable time gap between the adoption of an accounting standard by the IASB and its implementation in individual Member States. For certain standards (e.g. IFRS 9 concerning financial instruments or the standard for small and medium-sized enterprises), this procedure may last a couple of years. It can be, therefore, inferred that the IFRS-based standardisation of financial accounting does not mean achieving automatic compliance and comparability in various regions or countries in legal terms. In general terms, considering the specificity of countries/regions, resulting from cultural, mental, social, historical and other differences, achieving full comparability within a foreseeable period is hardly possible.

The reference Regulation imposed the obligation to draft consolidated IFRS-based financial statements, effective from the balance years beginning with 1 January 2005, on those companies whose securities were marketed in any of the Member States as at the balance-sheet date (The Regulation of 2002, Article 4). The decision on extending the catalogue of obligatory or voluntary IFRS-based reporting options to other companies was left to the Member States' discretion. Therefore, the European Commission allowed for the IFRS application by virtually all entities, whether they draft consolidated or unit-based financial

statements, and whether or not their securities are marketed publically (Regulation of 2002, Article 5).

Further to the adoption of Regulation No. 1606, the Polish Accounting Act had to be amended, as Polish companies were previously obliged to draft their financial statements by making the only and exclusive use of the principles of assets and liabilities valuation and determination of the financial result, as defined in the reference Act. Although in 2001 the Securities and Exchange Commission imposed an obligation on the companies listed on the stock exchange to disclose the differences between Polish regulations and the IFRS, this was only in qualitative, not quantitative, terms. The appropriate regulations were introduced by amending the Accounting Act of August 2004 (Journal of Laws No. 214, Item 2153), under which the Polish legislator extended to the banks the obligation to draft consolidated IFRS-based financial statements (Accounting Act of 2004, Article 55, Paragraph 5). The legislator further provided the possibility to draft IFRS-based reports, on a voluntary basis (at the verifying body's discretion), to the following entities (Accounting Act of 2004, Art. 54):

- issuers of *admitted* securities, i.e. issuers willing to apply for the admission to marketing on one of the regulated markets within the European Economic Area (both unit-based and consolidated),
- units forming part of an equity group, in which the dominating entity drafts consolidated financial statements according to the IFRS,
- branch offices of foreign entrepreneurs, provided that they draft financial statements according to the IFRS.

Therefore, the Polish legislator did not decide on the full adoption of the IFRS. There are still domestic entities which, despite their willingness to satisfy the stringent IFRS requirements, cannot do so. The Ministry of Finance, which regulated all accounting issues in Poland, adopted an evolutionary variant of changes to balance-sheet law, arising from adjustments to the requirements of the globalising world and progressing European integration.

This gives rise to the question of the role of the Accounting Act in the entities bound (whether obligatorily or voluntarily) by the IFRS. In fact, in accordance with Article 2, Paragraph 3, they apply the provisions of the reference Act, and the executive provisions issued on its basis, in the scope not regulated by the IASB. This means that wherever there are no specific IAS/IFRS regulations, they will first refer to the Accounting Act, and then possibly to domestic accounting standards. The provisions of the Accounting Act applied by the IFRS-bound entities, because of the absence of specific IAS/IFRS regulations, concern stock-taking, book-keeping, the principles of documenting economic events, the obligation to draft reports on current activity[4], the audit, approval and announcement of financial statements, data protection, and criminal liability.

The uniform text of the Accounting Act was published again this year (Journal of Laws of 2013, Item 330). This time, most changes which have occurred since the last but one publication of the uniform text in 2009 (Journal of Laws of 2009, No. 152, Item 1223)

[4] The obligation to draft reports on current activity may soon be included in international standards (as the work on further changes to IFRS 1 – Presentation of financial statements is now in progress), following which this regulatory area will no longer concern the IFRS-bound units.

resulted from other factors than the standardisation processes of corporate financial reporting.[5]

An assessment of the reaction of accounting entities and users to the changes to balance-sheet law

The reaction of accounting entities and users to the changes to balance-sheet law has been tracked using the example of changes to the Polish balance-sheet law which have occurred over more than ten years, and especially those caused by the adjustments to the requirements of EU regulations and IFRS.[6]

It should be noted that IFRS implementation is not an easy task. This is confirmed by an analysis of financial statements for the periods of transition to the IFRS and the subsequent periods of companies listed on the stock exchange in Warsaw conducted by the author for the purposes of this study. There are noticeable differences in the application of accounting principles between the first report prepared in compliance with IFRS and the next (and sometimes a few subsequent) reports. Usually they result from further adjustments of the reporting to international standards. This regards both the manner of presenting information in the report and the principles of valuation and formulation of particular items in the report. Also, accounting policies have evolved significantly. This study allows the conclusion that IFRS implementation is not a single action, or an easy and short-term one, but it requires excellent preparation, training and even – in a sense – a new understanding of the company, as reporting in compliance with IFRS requires more precise disclosures, viewing the company from a long-term perspective and heavy use of management accounting tools.

Accounting users notice that changing balance-sheet law towards their compliance with international standards bring about the harmonisation of internal reporting and better comparativeness between home and foreign companies, and in the case of entities active in many countries and continents, also harmonisation of internal reporting. This has been confirmed by the results of research conducted by PricewaterhouseCoopers (2006). The comparativeness of information is a very important feature of financial statements, regardless of the necessity to make analyses, establish changes and trends in the company's activities, and make proper investment decisions. That is why, to make it easier for recipients to compare the financial results obtained by companies conducting business in various countries, and to watch the character and dynamics of the changes occurring in companies, reports from various companies worldwide should be based on the same standards. At the same time a properly-prepared and useful financial statement should contain information comprehensible to the user (who has sufficient knowledge of the company's business activities and economics, and the functioning of the markets), thus the need for permanent training.

It should be noticed that in the first half of the 1990s in Poland, training sessions, courses and other forms of education were conducted at the universities and by the Association of Accountants in Poland (Jaruga *et al.*, 2007), covering international standards. These

[5] This is the outcome of reporting regulations through codified laws, which force continual amendments, while certain lack of flexibility results in the failure to adjust the amendment pace to the rapidly-changing economic environment.
[6] As regards the impact of the International Financial Reporting Standards implementation on a financial report, more than ten studies have been devoted to this issue, including: Jaruga *et al.*, 2007; Krzywda and Schroeder, 2007; Walińska, 2007.

initiatives have largely facilitated the practical implementation of international regulations. Nonetheless, professional courses, both for managers and for accountants, are still needed. This results both from the difficulty level of the IFRS as such, and their constant evolution, and from the expected increase in the number of companies reporting in accordance with the IFRS.

The noticed difficulties with IFRS implementation were most probably partially due to the lack of easy access to the contents of the international standards: the first official translation of the IFRS appeared as late as in the year 2004. This obstacle has already been overcome – the EU regulations make the publication of the IFRS obligatory (in the version accepted by the EU) in the official language of each Member State, Additionally, in Poland, with the participation of the Association of Accountants in Poland, every few years the standards are published in the version adopted by the IASB [International Accounting Standards Board] in the Polish translation in book form.

Some authors have pointed out that although reporting in compliance with the IFRS admittedly highlights the usefulness of financial information, but this is being done at the cost of comparativeness: *"in the case of the IFRS it is not possible to talk about reliability or comparativeness if there are several various answers in response to the question how to post or present a certain transaction in a financial statement*" (Kamela-Sowińska, 2006). Then, paradoxically, the implementation of identical reporting standards deprives the reports of the ability to make comparisons between various entities conducting business in the same country. This had been confirmed by research conducted, among others, by Ernst&Young in September 2006 (Observation, 2006).

The difficulties encountered by Polish business in the implementation process of international standards resulted from the typical continental model of domestic accounting, based on legal principles, with the superiority of the prudence principle, the weak position of the principle of business continuity, and the prevalence of content over form and the reluctance to extensively disclose financial data. The research conducted by Cebrowska, (Cebrowska, 1998) proved that Polish accountants prefer normative regulations and do not see a need to allow alternative solutions. Other research (Vellam, 2004) indicates that in Poland the main purpose of creating financial statements is not to satisfy the needs of a wide circle of users (including investors), but primarily to meet the requirements of the law, especially accounting law. Also, an analysis of court decisions proves that accounting law is the basis for judgments, which may result from insufficient knowledge on the part of the judges regarding the purposes and role of the accounting-information system. Apart from that, doubts occur as to the proper application of professional judgment, widely required by the IFRS, needed for the proper posting and valuation of many report items. Concerns exist over the possibility of abusing the estimating process based on the [professional] judgment to manipulate financial data. Similar doubts have been expressed by Romanian researchers (Ovidiu, 2011).

Probably, if relevant research was conducted in 2013, it would turn out that the pressure for a legalistic approach to accounting is weaker, especially in public entities because basing accounting on principles (not on rules) allows entities to "tailor their accounting policy to their needs", and because of that the image of the enterprise emerging from the statement might better reflect the economic realities of the enterprise. What's more, the increase of authority is very much appraised by investors, especially minority stakeholders, who, as such,

do not have access to internal statements. The IFRS disclosures policy is designed in such a way that a financial statement may primarily aid rational decision-making, so consequently it has to include an abundance of management information, while the disclosures complying with the requirements of accounting law primarily serve the implementation of the attesting and controlling functions of accounting.

Along with the noted advantages of the harmonisation and standardisation of accounting there are emerging doubts related to this. More and more tangible is the complexity of financial statements preparation processes, so that even accounting specialists have difficulties with interpretation and comprehension of the economic logic of accounting law regulations. Apart from that, it was noticed a long time ago that the more detailed amendments to the law, including accounting law, the more possibilities to evade it (Mączyńska, 2009).It should be the purpose of the regulators to design such laws which, not leaving doubts as to their interpretation, would at the same time allow sufficient flexibility, and thus, not bring about the necessity for further amendments.

CONCLUSIONS

The directions of changes occurring in accounting worldwide are being charted by International Financial Accounting Standards and their continuation in the form of International Financial Reporting Standards. In Poland, the practical appliance of accounting principles is "double-tracked": out of all the accounting entities, the majority is formed by the entities which practise accounting in compliance with the Accounting Act, and the other group of business entities keeping accounting books and prepare financial statements applies International Financial Reporting Standards (IFRS). According to official State statistics a little over 2% of all companies preparing financial statements reported compliance with the IFRS (1198 out of 53 148 entities)[7]. The role of the IFRS is bound to be growing. Poland is in the process of preparing further very important changes to balance-sheet regulations. The final shape of the standards is not yet known; consultations in this field are in progress. The expected changes are going to be significant enough to make an amendment insufficient and a new Act of law is going to be developed. Probably the Act is going to be divided into 3 parts:

1) regulations common to all entities preparing financial statements (also based on the IFRS),
2) regulations for small and medium-sized enterprises (with a number of simplifications provided for, decreasing the difference between balance-sheet regulations and tax law,
3) regulations for entities subject to the duty to have financial statements audited (stronger harmonisation of reporting with the IFRS).

The long period of preparing changes to balance-sheet regulations is – on one hand – related to the need to conduct very extensive consultations with a number of stakeholders, and, on the other hand – it is justified by the wait for the decisions of the European Committee and the Council with regard to reporting by small and medium-sized companies (it seems the IASB standard regarding these entities is not going to be adopted in *acquis communautaire* and extensive work is in progress on the directive regarding accounting in the SME sector).

[7] According to the data of the Central Statistical Office for the year 2008. The information was not gathered in the subsequent years.

Moreover, further changes to international standards, as such, are expected, due to their progressing convergence with the US GAAP (Generally-Accepted Accounting Principles) and the inevitable introduction of requirements for integrated reporting (for more on these subjects see Kobiela-Pionnier, 2012; Ignatowski, 2012), as well as with the possibilities and requirements of reporting with the use of XBRL (eXtensible Business Reporting Language). Therefore, the subject of this study is going to remain currently valid and will require further even more significant analyses, as the knowledge of the reactions of stakeholders to the changes to the balance-sheet regulations will allow the planning, and then the implementation, of subsequent amendments to the balance-sheet law.

The systematisation of data on past experiences related to the implementation of international practices and regulations in the accounting of a given State facilitates predictions as to the possible reaction and warns business practitioners and lawmakers about changes in the future. This will allow the assessment of the speed and extent of the changes, as well as the level of acceptance and perception of the reporting requirements by those preparing and those using the reports alike. This knowledge is especially important for lawmakers and regulating bodies, as it will allow them to property plan the process of legal-changes implementation. The example of Poland may be used to predict the behaviour of the other countries with similar experiences from the past related to the transition from the centrally-steered system and international isolation, and the subjecting of balance-sheet regulations to tax law and the legalistic concept of statehood. This study may be valuable for a group of developing countries which are about to make decisions on the direction of the financial-reporting harmonisation process, such as Nigeria, Turkey, Ukraine, India, Brazil, Argentina, Vietnam, and many others (an interesting study on the expected benefits and the impact of culture on the IFRS implementation process may be found in Lasmin, 2012; Terzungwe, 2012).

REFERENCES

1. *The Regulation (2001) of the Minister of Finance* of 28.11.2001 on the scope of actions and the method of organisation of the Accounting Standards Committee, Journal of Laws of 2001, No. 140, item 1580.
2. *Regulation (EC) No. 1606/2002 of the European Parliament and of the Council of 19 July 2002 on the application of international accounting standards,* the EC Official Journal of, *L 243 of 11.09.2002.*
3. *The Regulation of the Minister of Finance* of 15.01.1991 on the rules of book-keeping, Journal of Laws of 1999, No. 10.
4. *The Regulation of the President of the Republic of Poland* of 27.06.1934, The Commercial Code, Journal of Laws of 1934, No. 57, item 502, (KH).
5. The Accounting Act (1994) of 29.09.1994, Journal of Laws of 1994, No. 121, item 694.
6. Biadacz, R. (2012), „Plany kont w Polsce – zarys historyczny", in: Rachunkowość – wybrane problemy naukowo-badawcze, Sojak, S. (Ed.), UMK, Toruń, pp. 23-47.
7. Brzezin, W. (1995), Ogólna teoria rachunkowości, Wydawnictwo Politechniki Częstochowskiej, Częstochowa.
8. Cebrowska, T., Kasperowicz, A., Pasławska, A., (1998), „Niejasności zapisów ustawy mankamentem prawa bilansowego", Zeszyty Teoretyczne Rady Naukowej SKwP, t. 48, pp. 99-107.
9. Foremna-Pilarska, M. and Radawiecka, E. (2007), Rachunkowość na tle rozwiązań międzynarodowych, Difin, Warszawa, p. 11-44.

10. Gnich, J. (2002), Komentarz do znowelizowanej ustawy o rachunkowości. Poradnik dla małych i średnich przedsiębiorstw, PARP, Warszawa.
11. Holban, I. (2011), „Accounting normalization: a conceptual framework system", Global Conference on Business and Finance Proceedings, vo. 6, no. 2, pp. 35-40.
12. Ignatowski, R. (2012), „Światowa harmonizacja rachunkowości w perspektywie teoretycznej, Zeszyty Teoretyczne Rachunkowości, no. 67(123), pp. 33-53.
13. Jaruga, A. (2002), „Instytucjonalizacja międzynarodowej harmonizacji rachunkowości," in: Międzynarodowe regulacje rachunkowości. Wpływ na rozwiązania krajowe, (Jaruga, A. (Ed.), C.H.Beck, Warszawa, pp. 22-78.
14. Jaruga, A. and Szychta, A., (1997), „The origin and evolution of charts of accounts in Poland", The European Accounting Review, 6:3, pp. 509-526.
15. Jaruga, A. Fijalkowska, J., Jaruga-Baranowska, M., Frendzel, M., (2007), " The impact of IAS/IFRS on polish accounting regulations and their practical implementation in Poland", Accounting in Europe, vol. 4, no. 1, pp. 67-78.
16. Kamela-Sowińska, A. (2006), „Wprowadzenie", in: Gut, P. Kreatywna księgowość a fałszowanie sprawozdań finansowych, C.H.Beck, Warszawa, pp. 14-16.
17. Kobiela-Pionnier, K. (2012), „Sprawozdawczość zintegrowana: koncepcja raportowania osiągnięć przedsiębiorstwa na miarę XXI wieku", Zeszyty Teoretyczne Rachunkowości, no. 66(122), pp. 75-85.
18. Krzywda, D., Schroeder, M., (2007), „An aalysis of the differences between IFRS and polish accounting regulations: evidence from financial systems of listed entities on the Warsaw Stock Exchange for the calendar years ending 2001, 2003 and 2004", Accounting in Europe, vol. 4, no. 1, pp. 79-107.
19. Lasmin, D. (2012), „Culture and the globalization of the International Financial Reporting Standards (IFRS) in developing countries, Journal of International Business Reasearch, vo. 10, special issue, no. 2, pp. 31-44.
20. Mączyńska, E., (2009), „Siła, tradycja i grzechy rachunkowości", Rachunkowość, no. 10., pp. 2-8.
21. Misińska, D. (2005), „Harmonizacja rachunkowości", in: Rachunkowość finansowa i podatkowa, Cebrowska, T. (Ed.), PWN, Warszawa, pp. 119-132.
22. MSSF: Punkt widzenia europejskich inwestorów. 2006, in: Śnieżek, A., Wiatr M.(2007), Wdrażanie MSR/MSSF w polskich spółkach publicznych a porównywalność sprawozdań finansowych na przykładzie rachunku przepływów pieniężnych – głos w dyskusji, in: Rachunkowość w teorii i praktyce, T.III, Gabrusewicz, W., Ed.), Wydawnictwo Akademii Ekonomicznej w Poznaniu, Poznań.
23. Mućko, P. (2009), „Stan harmonizacji i standaryzacji rachunkowości", in: Rachunkowość międzynarodowa, Winiarska, K. (Ed.), ODDiK, Gdańsk, pp. 47-68.
24. Observation on the implementation of IFRS – part1, Ernst&Young, september 2006.
25. Ovidiu, M., „Professional judgment under IFRS in ex-communist countries: case of Romania", The Annals of the University of Oradera. Economic Science Series, vol. 1, pp. 564-570.
26. Rapacki, R. (2005), „Przekształcenia własnościowe w Polsce w latach 1990-2003", in: Gospodarka polska na przełomie wieków od A do Z, NBP, Warszawa, pp. 37-60.
27. Terzungwe, N. (2012), „ Expected benefits of implementing global accounting standards by nigerian business entities, International Journal of Business and Management, vol. 7, np. 15, pp. 98-104.
28. Vellam, I. (2004), „Implementation of International Accounting Standards in Poland: can true cnvergence be achived in practice?", Accounting in Europe, vol. 1, pp. 143-167.

29. Walińska, E. (2007), „Wpływ międzynarodowych Standardów Sprawozdawczości Finansowej na zasady prezentacji informacji w bilansie oraz rachunku zysków i strat", in: Wpływ międzynarodowych i krajowych regulacji sprawozdawczości finansowej i auditingu na zamiany w praktyce rachunkowości 9Sobańska, I., and Szychta, A. (Ed.), Wydawnictwo Uniwersytetu Łódzkiego, Łódź, pp. 215-232.
30. Weresa, M. (2002), „Skutki inwestycji zagranicznych dla gospodarki kraju przyjmującego – doświadczenia Polski", Zeszyty BRE Bank-Case, No. 67, pp. 7-42.

BIOGRAPHY

Malgorzata Kamieniecka, Ph.D., Vice Dean for Students of the Faculty of Economics, Maria Sklodowska-Curie University, Poland. The associate professor in Accounting Department. She runs a variety of courses in accounting and economics for 12 years. M. Kamieniecka has supervised about 30 bachelor and master's theses. She is the author of about 40 scientific publications. Her research interests focus on broadly defined financial reporting of enterprises and the impact of tax regulations on accounting information system. Kamieniecka is a board member of the Accountants Association in Poland, branch Lublin. She took part in the work of the scientific committees and organization of several international conferences in finance and accounting. She won a few rewards (Dean and Rector) for scientific and teaching-organizational work.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

INVESTMENT ANALYSIS IN PUBLIC-PRIVATE-PARTNERSHIP PROJECTS: ANY COMMON GROUND FOR PUBLIC AND PRIVATE INVESTORS?

Pekka Leviäkangas, Research Professor, Department of Industrial Engineering & Management, University of Oulu
pekka.leviakangas@oulu.fi

Pekka Kess, professor
University of Oulu

Jaakko Kujala, professor
University of Oulu

ABSTRACT

Purpose (mandatory): *The purpose of this paper is to show analytically that cash flow – based project analysis of private investors and cost-benefit analysis of the public sector conflict in many points in public-private partnership projects.*
Design/methodology/approach (mandatory): *The method of analysis is based on cash flow accounting and cost benefit analysis. A single-project company is used as a demonstrating case. The flows of cash (private investors) and flows of costs and benefits (public investors) are integrated in a single analytical framework.*
Findings (mandatory): *The findings show that the investors' (public vs. private) social, economic and financial targets are not necessarily coinciding. Prospecting of common ground and win-win situations becomes a crucial success factor for any public-private partnership project.*
Research limitations/implications (if applicable): *The current research on public-private partnerships is much focused on project delivery methods, contractual issues and discussion on the need of public-financed comparator. This paper will clarify the real problems faced.*
Practical implications (if applicable): *The paper will set some guidelines how to find the common ground for successful PPPs. It also points out potential conflict areas.*
Social implications (if applicable): *The paper in itself contains an element of socio-economic appraisal of projects that will increase the wealth and well-being of people.*
Originality/value (mandatory): *The originality of the paper lies on its generic approach to single-project valuation problem, combining the both sides of valuation aspects: private and public investors.*

Keywords: public-private partnerships, investment, project, cost-benefit, finance

INTRODUCTION, SCOPE AND OBJECTIVES

To overcome the problems of funding capital investments for example in transport, energy, and utilities sector, a number of solutions concerning capital provision, contractual arrangements, off-balance sheet financing (from the viewpoint of the state), among other means, have been introduced. For road transport projects, where the users are mostly individual drivers, tolling of road use is perhaps the most common manner of capital finance. Analogically, electricity customers pay the capital investments through their electricity bills. The capital investment recovery can be arranged in many other ways too: for example, through availability payments, shadow tolls, grants, exclusive monopoly positions, etc. Typical for these alternative arrangements, or arrangements that one way or the other supplement end users payments, is the public intervention in guaranteeing the revenues for the investors that provide the initial capital outlay to build the physical facility offering the service in question.

The approach of introducing private investors to finance, build and operate a major facility on behalf of the state, city, municipality or some other public entity is globally termed as public-private partnerships (PPP or 3P). The partnership is built on long-term contracts, concessions or leases to enable private investors to construct the facility and provide services to the public according to agreed – and in most cases very complex and extensive – contracts. The contractual side of PPPs is well covered in the management literature of infrastructure, transport, energy, finance, public economy, for instance, and good overviews are provided e.g. by European Investment Bank (Uppenberg *et al*., 2011), the World Bank (Estache *et al*. 2007 for transport; Marin, 2009, for water supply in developing countries, Cuttatree and Mandri-Perrott, 2011) and Organisation for Economic Co-operation and Development (OECD, 2008; Araújo and Sutherland, 2010).

Another feature that is quite common, though not exhaustive, for major PPPs is the project financing nature of investment and the whole life cycle of the effort. A project company is built up by the investors and the project company starts to prepare for the capital investment and finally for the operating phase of the investment. The reasons for setting up a separate project company are at least two-folded. First, the risks of the investment, of which the investors and the public side of the partnership could have an incomplete and uncertain picture, are isolated hence into a single-project entity and the investors are liable just to the extent of their invested capital to the project company. Secondly, for the public partners the single-project company represents a more transparent entity which is easier to monitor in terms of performance, service quality and finance than a larger and multi-business-segment entity, where the "project" represents just one among many.

The principle features of project financing are as follows (Brealey *et al.,* 1996, p. 25):

- The project is established as a separate company which operates under a long-term contract (a concession) obtained from the host government.
- A major proportion of the equity capital of the project company is provided by the project manager or sponsor, tying the provision of finance to the management of the project.
- The project company establishes comprehensive contractual relationships between the suppliers, customers and host government organizations.
- The project company is highly leveraged financially.

The project cash flows are divided by equity investors, debt investors, contractors and suppliers and users that receive the service. Equity investors are often the founders of the project company (i.e. contractors, developers, public authorities) and financial institutions that seek long-term investment opportunities, such as pension funds and insurance companies. Even individual persons can be equity investors if share issues are made public. Debt investors are usually banks, investment funds, and etc. that operate in the financial market routinely.

This paper forms a holistic and generic cash flow model on a single-project company and applies it in a framework where also the public benefits are included. Thus the model creates an analytical frame where each stakeholder's economic and financial positions can be pointed and studied. The model enables empirical data to be fed in in order to research real world examples and hence it provides a platform for further empirical analysis. The model has been already successfully applied to the first Finnish PPP road project, the E4 between Helsinki and Lahti (Leviäkangas, 2007).

This paper is furthermore a theoretical analysis more than an empirical one, but the model provided is relatively simple and allows first meta-analysis of large projects. However, the model is unable to capture contractual finesses which could have a radical impact on project outcomes from the viewpoint of stakeholders and project partners. (Leviäkangas *et al*., 2013) Methodologically, this paper falls in the cross-section of cost-benefit and cash flow analysis, bearing therefore an emphasis on investment theory, but both from the economic and corporate finance angles. This attempt to combine the public side's cost benefit analysis (CBA) and private side's financial analysis is the added value to the body of knowledge.

MOTIVATION FOR PPP: LITERATURE

The European Investment Bank approximated that on average about 3.9 percent of GDP was invested in infrastructure projects – including transport, health, education and utilities (electricity, gas, water supply) – in the European Union by old member states and about 5.1 percent by the new member states for 2006 – 2009 (Wagenvoort *et al*., 2010). These figures show how significant amounts are at stake.

Investors have been keen on infrastructure assets, but distinctive differences are within different classes of infrastructures (Inderst, 2010) as well as there are differences between investing in infrastructure funds and direct investing in specific projects (Bitsch *et al*., 2010). This paper deals with the latter alternative, i.e. direct investment in a single-project company.

PPPs have been endorsed owing much to their ability to clean governments' balance sheets. However, the new rules set in Europe by Eurostat in 2004 have taken partly away this advantage: any public sector commitments made towards PPP projects are now accounted as public obligation and recorded in national accounts accordingly, but yet depending on the level of risks borne by the private sector investors (Posner *et al*., 2009). The situation is not necessarily the same across the globe, though, and in some countries PPPs probably continue to work as an effective off-balance sheet financing tool for the national and/or local government.

PPPs are seen as a key to increase efficiency in service delivery, due to the hypothesis that private sector is more efficient in providing services for consumers or citizens than the public sector (see e.g. UNESCAP, 2011; Alfen *et al*., 2009), although truly empirical findings are scarcer – and some early experiences are controversial and the final truth seems to be highly contextual (Burger and Hawkesworth, 2011). Engel *et al*. (2010) argue that higher costs often encountered in PPP projects is not as such an argument in favour of public provision as these costs could imply deficient contract design rather than high costs *per se*.

SINGLE-PROJECT COMPANY – ANALYTICS OF CASH FLOWS AND BENEFIT GENERATION

The single-project company is shown in Figure 1. Its stakeholders include the aforementioned investors (debt and equity), the state, users, and suppliers and service providers. There are real cash flows between the project and its stakeholders and then there are less tangible benefits for the users, which do not necessarily account for cash flows but are nevertheless significant with regard to project's socio-economic appraisal. For example, transport projects' safety and travel comfort do not in all cases transfer to cash flows, but are still relevant criteria for the project to be accepted by the political machinery and general public.

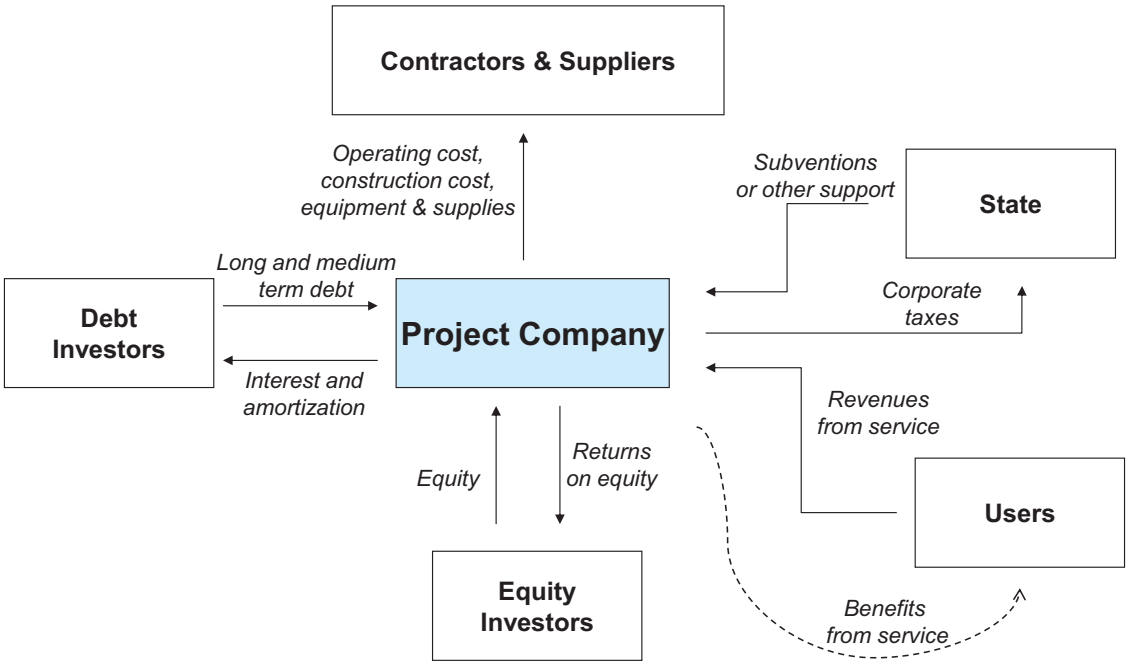


Figure 1. Single-project company (modified from Leviäkangas, 2007)

The above conceptual model can be translated into an analytical one. To start with, the following symbols are used:

Rev = revenues of the project company; the revenues are divided into revenues from users and revenues from the state: $Rev = Rev_U + Rev_S$

Ope = operating expenses of the project company; these are mainly all-year-round road maintenance and operating costs

ES = equipment and supplies costs needed for the build-up of the facility; running costs of materials etc. are included in operating costs *Ope*

Con = construction cost, i.e. the expenses of constructing the facility
C = total life-cycle monetary before-tax costs for the project company; $C = Con + ES + Ope$
Tax = corporate taxes paid by the project company
E = equity capital invested in the project company
D = debt capital raised by the project company
iD = interest on debt capital
A = amortisation of debt
Dep = depreciation of the project company's assets
T_c = corporate tax rate
Ben = benefits accrued to the users in socio-economic cost-benefit analysis (CBA)
Ext = external costs related to the project, included in CBA.

Only corporate tax is assumed, and any other taxes excluded, such as taxes of bondholders and equity holders. It is further assumed that the project company distributes immediately all the net cash flow earned to shareholders as dividends. This is a reasonable assumption since the whole idea of the project is to generate adequate and as-early-as-possible cash stream to investors. This at least partly removes the need for other tax considerations, as it is assumed that investors' net cash flows are treated according to other tax regimes, i.e. as personal income or corporate taxes of other owner entities. All cash and other monetary flows are shown in present value form, discounted by the rate that each actor prefers. Thus the same flow, e.g. outflow of the state and inflow of the project company are not of same present value to these stakeholders.

The free cash flow to investors (*FCF*) is the measure of wealth increase for them. This surplus is available for investors after their initial capital outlays (*E, D*). The free cash flow for shareholders which is after-tax net cash flow plus tax advantages from depreciation and interest payments

$$FCF = (1 - T_c)(Rev - Con - ES - Ope) + T_c Dep + T_c iD$$
$$= Rev - Con - ES - Ope - T_c(Rev - Con - ES - Ope - Dep - iD) = Rev - C - Tax$$

because taxes paid by project company must be

$$Tax = T_c(Rev - Con - ES - Ope - Dep - iD)$$

Since the calculus is done in present value terms it can be assumed that costs of construction, equipment and materials, *Con* and *ES,* equal *Dep* and should not be double-counted, we can simplify, because *Con, ES* and *Dep* occur in different accounting periods but must approximately at the end of the day equal to each other, and since operating expenses are as well tax deductible:

$$Tax = T_c(Rev - C - iD)$$

The total cash flows to single project company equity holders are defined as after-tax net revenues minus costs and expenses less the initial equity outlay, deducted further by debt service payments (amortization and interest)

$$TCF_E = (Rev - C - Tax - iD - A) - E$$

and the total cash flows to debt holders is the debt raised by the project company from the debtors plus the received debt service payments

$$TCF_D = (iD + A) - D$$

Summing these two form the total cash flows of the single-project company

$$TCF_E + TCF_D = Rev - C - Tax - (E + D) = FCF - (E + D)$$

which states that the incremental value produced by the single-project company to its owners is the free cash flow minus the initial capital outlays of equity and debt – as should be. The sum of owners' cash flows represent the project investors' investment's net present value followed when their invested capital is subtracted from present value of project company's cash flows.
The market value of the project company is the present value of free cash flows, i.e. the initial capital outlays plus the incremental value:

$$V_p = FCF = E + D + TCF_E + TCF_D$$

Depending on the leverage ratio of the project company the market value is different for the equity and debt. The market value of debt is the initial debt outlay plus the incremental available to debt holders

$$D_m = D + TCF_D = D + (iD + A) - D = iD + A$$

The market value of equity is the initial equity outlay plus the incremental available to equity holders

$$E_m = E + TCF_E = E + (Rev - C - Tax - iD - A) - E = FCF - iD - A = FCF - D_m$$

The market value of the single-project company may then be written as

$$V_p = E + D + TCF_E + TCF_D = (E_m - TCF_E) + (D_m - TCF_D) + (TCF_E + TCF_D) = E_m + D_m$$

STAKEHOLDERS' ECONOMIC AND FINANCIAL POSITIONING

1. Financial and economic flow matrix

Table 1 shows the flows of cash between stakeholders. The cash flow matrix indicates that it is fairly straightforward to calculate each stakeholder's net cash position, column by column. The non-cash items, i.e. the benefits and external costs generated by the project can usually be monetized according to standard cost-benefit analysis. The problem in many countries is that the standard does not exist, whereas for instance in the Nordic countries CBA is well standardized e.g. for transport infrastructure development projects. For many other marginal system improvements the situation is not necessarily so, even in Nordic countries. For example, the meteorological services are regarded highly beneficial for the society and users

of services, including both private citizens and organizations, but their benefits are studied seriously only recently (see e.g. Leviäkangas, 2009; Leviäkangas and Hautala, 2009). The benefits of any service provided by PPP projects, be they financial (cash) or otherwise monetized (non-cash), are highly dependent on not only their recognition but also on the valuation techniques applied (Leviäkangas, 2009).

Benefits that are usually non-cash but still paramount as socio-economic gains vary according to project type:

- transport infrastructure projects: typically accident cost savings, time cost savings
- water supply projects: health impacts
- energy projects: economy-wide external benefits.

Table 1. Cash flows, costs and benefits of PPP project (modified from Leviäkangas, 2007).

Equity investors	**Debt investors**	**Project company**	**Users**	**The state**	**Contractors & suppliers**	**Notes & explanations**
$-E$		$+E$				Equity investors invest E in the project company
	$-D$	$+D$				Debt investors invest D
		$-Con$			$+Con$	Project company constructs at expense C
		$+ Rev_U + Rev_S$	$- Rev_U$	$-Rev_S$		Project company receives revenues from the state
		$-Ope - ES$			$+Ope + ES$	Project company pays contractors for the operating (e.g. maintenance)
	$+iD$	$-iD$				Project company pays interest on debt
	$+A$	$-A$				Project company amortizes the debt
		$-Tax$		$+Tax = T_c(Rev - C - Dep - iD)$		Corporate taxes after expenses, depreciation* and interest
$+[(1 - T_c)(Rev - C) + T_cDep + T_ciD]$		$-[(1 - T_c)(Rev - C) + T_cDep + T_ciD]$				The surplus cash flow available for shareholders, paid by the project company**
			$+ Ben$ $- Ext$			The state accounts for benefits of users and third parties, i.e.

Equity investors	Debt investors	Project company	Users	The state	Contractors & suppliers	Notes & explanations
						the external benefits, as well as external costs

*Depreciation (*Dep*) equals the cost of depreciated assets (*C*); it is a matter of depreciation technique, existing accounting regulations and practices and, to certain extent, managerial choice how much of the incurred construction expenses are activated immediately in the income statement and how much are kept in the balance sheet as deferred expenses to be activated later as depreciation; at the end of the day, *C* must equal *Dep* and they must be accounted only once per accounting period.

** The available surplus for investors after interest and taxes = $(1 - T_c)(Rev - Con - ES - Ope - Dep - iD) = Rev - C - Ope - Tax$ = Free cash flow (*FCF*).

What is furthermore typical for these types of PPP projects is that some of them involve the direct collection of revenues based from the users of the service and possibly also from the public client - here it is referred to as "the state" but it could be any public agent working on behalf of the community and/or society. It is an inescapable fact that without these revenues any PPP is impossible to implement and the business case for private investment is missing.

The rules to satisfy different stakeholders' economic rationale are as follows. The shareholders of the project company must receive enough cash flow in order to cover their initial equity capital investment plus the interest they have placed on their equity:

$$(1 - T_c)(Rev - C) + T_cDep + T_ciD - E > 1 \Leftrightarrow (1 - T_c)(Rev - C) + T_cDep + T_ciD > E \Leftrightarrow FCF > E$$

stating simply that after-tax net cash in present value terms (discounted by required return on equity) after all costs in the project, and after interest and depreciation tax benefits (because these are tax deductible) must be greater than the initial equity placement.

In fixed period concessions, the project company is left in the end with empty pockets and liquidated after it has fulfilled its task of delivering the service. When the project company is expected to continue its existence over an indefinite period of time, the shareholders must consider the liquidity position of the company and other long-term obligations, such as pensions and re-investments.

For debt investors the rule is equally simple: the debt allowed to the project company must be paid back in full with required interest. Hence the interest and amortization cash flow in present value terms, discounted with required return of the debt holders, must exceed initial debt outlay:

$$iD + A - D > 0 \Leftrightarrow iD + A > D$$

For suppliers and subcontractors the case of project's profitability is of secondary importance as long as their contracts with the project company are economically worthwhile.

2. Cost-benefit rule

And it is now when the picture becomes more blurred: the net benefits that are received by the users and society (or community) as a whole must exceed the payments made to the project company, i.e.

$$Ben - Ext > Rev_U + Rev_S - Tax$$

which is in fact the comparison of benefits and costs of the project, and the aggregate benefit cost ratio is then simply

$$(Ben + Tax) / (Rev_U + Rev_S + Ext)$$

If we assume that the project is equally beneficial as PPP or as traditional public financed project (i.e. benefits remain constant), the comparison between PPP and traditional procurement (from the viewpoint of the state) must be done between revenues paid by the state and users and costs of the project. Would the costs be greater with traditional model than the revenues paid to the project company? Again, the comparison itself is rather straightforward and it brings forth the potential efficiency of the private sector, which on the other side is offset by the higher returns of the private investors.

Since many of the benefits received by the users or by the public can be non-cash, and sometimes very difficult to monetize, there is always room for speculation about the socio-economic profitability of the project. The more there are non-financial benefits to be considered, the more complex, blurry and debatable the picture gets. There is also the question of direct user financing and state (public) support and how these are divided between users and the state. For example, in shadow toll roads, where the state covers the "tolls" directly from its budget on behalf of road users, there is a justified argument that the rest of the tax payers are paying the road on ultimate beneficiaries' behalf. The same argument applies to state subsidies, be they in the form of grants or tax reliefs – the large crowd of tax payers is supporting a project that benefits perhaps only a local community, some restricted area of the country or a specific user group. A perhaps unlikely, but not totally unknown scenario of PPPs is encountered when the state decides on purely user financed projects just to be able to collect more tax revenues.

From users' point of view, there is a crucial difference how large the public intervention is, since it reduces their own payments for the service. The more direct are the user benefits, the more willingness to pay there is from the side of users. So, on one hand, for example, the private health care services have always been well-off even in countries where public health care is of wide coverage. The basic human need dictates a good business case for such services. On the other hand, it is difficult to picture an entirely privatized health sector that would not lead to severe social problems.

When user benefits are not that directly related to individuals' consumption power or well-being, the willingness to pay is reduced: the willingness to pay for safer travel is probably not significantly higher than willingness to pay for the mobility service in general. These social benefits sometimes represent a significant sum of the benefits of projects. For example, the

Finnish road projects' benefits are dominated by time savings and accident cost savings. The latter item represents on average more than one third of the total benefits of average road investments (Tervonen *et al*., 2010).

3. Uncertainty and risk

When decision making concerning investments is risk-neutral, the expected values of discounted cash flows and benefits may be used. The problem usually arises when in practice the public sector does not adjust their analysis (CBA) for risk whereas private sector does it with great piety. One place where this makes the difference is the discounting rate different parties use. The risk-adjusted rates of returns for private investors are by and large higher than those set by public investors. (However, this difference has been narrowing to almost non-existing in Europe, where some governments' credit ratings have been in fact riskier than private companies').

Private investors are not risk-neutral but risk-averse - no investor wants to take any more risks than necessary. This in turn means that the expected positive cash flows will have less present value than in risk-neutral case, and their value relative to investment outlay that occurs in the front end of the project will decrease.

DISCUSSION

A good project is a good project. Using different financing mechanisms does not change the nature of the project itself. It is a recognised fact that many countries have used PPPs to leverage their infrastructure and expanding it beyond true needs and hence including projects in their investment programs that would not have been financed via conventional routes, e.g. through state budget. In these cases these investments have led to excessive infrastructure with poor returns in the end. For instance, a significant share of Portugal's main road investments were carried out as shadow toll PPPs, which resulted in a severe financial distress of the state (Cruz and Marques, 2011). Later, many of these projects were changed into conventional toll roads, where users pay for real. In addition, PPPs have been used as an emergency exit from unsustainable public budget deficit leading to overinvestment or long-term commitments to pay off the private investments that put the state in even tighter position after state's payments for the service are due.

Another example comes from Finland. The first PPP project in the country was an upgrading of semi-motorway E4 between Helsinki and Lahti to a full motorway, meaning in essence the building of the second carriageway next to existing motorway and constructing new bridges and levelled intersections. Again, the shadow tolling was used as a financing method so that the state paid "tolls" for each vehicle kilometre travelled on the road. The project was analysed in detail to the extent that public documents allowed and it was reported that the state paid more for the road in the long run than it would cost using traditional public project procurement. (Leviäkangas, 2007) On the other hand, the project was built well ahead of planned schedule and has served the road using public in an impeccable manner.

The above arguments lead to the conclusion that direct user financing is most likely to be a more sustainable financing mechanism than such where the state or some other public intervention is stronger. Projects that often offer the possibility of direct user finance are such

where the service is tangible and there is a tradition of paying for it. Electricity, heating, public transport, water, etc. are the kind of services where users already are accustomed to pay, and hence these types of projects are easier to justify and there needs to be less government intervention. Some of these projects can rely on business customers: airports are in the end paid by airlines and ports by shipping lines, because visiting the service (i.e. infrastructure) is not free of charge. Thus there is a strong link between customers' willingness (and note, *tradition*) to pay and provide real cash in return of the service. This conclusion was also reached in Leviäkangas *et al*., (2011) when investigating the returns of Finland's infrastructures (roads, rails, ports, airports, water, energy). Especially basic need satisfying services, such as water and energy, proved to be very profitable.

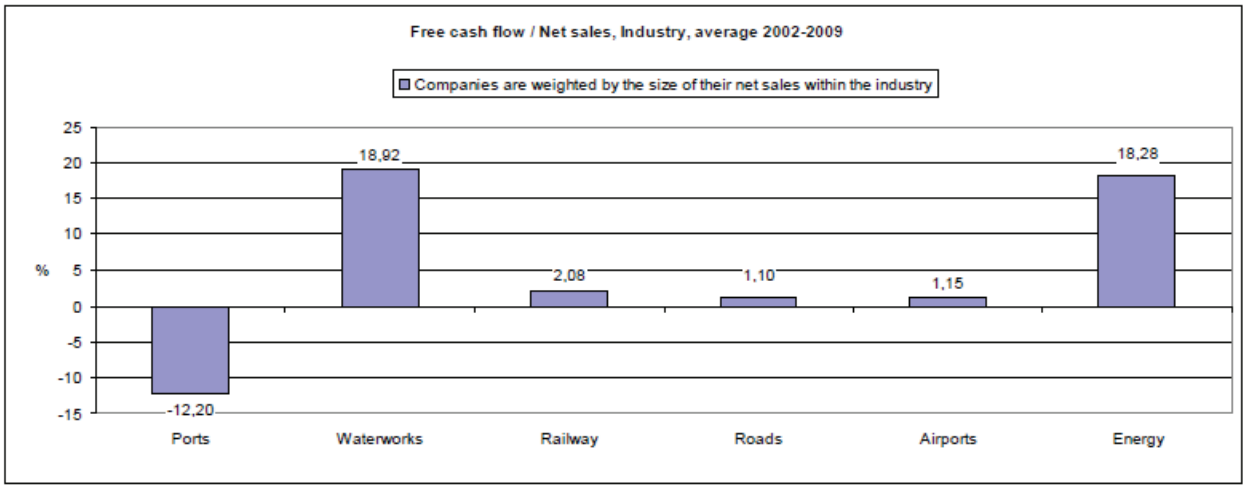


Figure 2. Free cash flows provided by infrastructures to their owners; the sample includes both public and private infrastructures (source Nokkala et al., 2011).

Since it is the after-tax net cash flow that dictates the project's financial viability to its owners, and since these revenues must come from the users or the state or both, it is the revenues and generated benefits that dictate almost the whole framework of PPPs, whether they are economically and financially sustainable in the eyes of investors and greater public. Benefits must exceed the revenues (as in our equation earlier) and revenues must exceed all costs and capital repayments. The more there are non-cash benefits, e.g. socio-economic returns, the more likely is the state or some other public financing called for, whereas when users receive tangible benefits directly, like water and electricity, the less likely is the need for public intervention.

Benefits such as safety or reliability belong to the category for which the real market-based willingness-to-pay is highly uncertain. Quite often research is carried out to point out the willingness-to-pay but these are typically stated preferences and not truly market tested. Willingness-to-pay is ultimately always tested by the market and if it remains untested, relying on it may be over-optimistic.

In sum, the analytical model points to the direction of prior studies. Private investors must rely on real cash flows and this may be ensured best by putting the service provision under market test and building on direct payments from the users. From the private investor point of view, the difference between state-paid and user-paid revenues is insignificant and if there is

a difference, it is likely to be in favour of the state. A state is, in most cases, less volatile customer than the consumers – provided of course that the government and political context can be regarded as stable. This is also something for the state and governments of recognize: involving themselves in the revenue logic of PPP projects they should be aware that they lower the risks of investment perhaps considerably. And this of course should be reflected to the returns paid to the investors.

For private finance policy the aforementioned reasoning seems to imply that only truly good projects with real, tangible service provision, should be considered to be implemented as PPPs. Poor projects that do not survive administrations' internal competition are not the best projects for PPPs, but vice versa. Also projects that must rely on market demand are probably the most suitable PPPs. Since PPPs have been applied to hospitals and schools in addition to traditional infrastructure projects, we should carefully distinguish who ends up paying for the project. A hospital may be a good thing, but unless it is completely private from the very start, the full amount of required revenues cannot essentially come from "customers", i.e. the patients, and the public sector must step forward to cover the investment amortization and running costs using tax payers' money.

Finally, we should perhaps detach ourselves from infrastructure –related thinking because infrastructures are highly capital intensive projects where revenues must be substantial in order to cover all costs and returns. Service sector is something where PPPs have been applied much less and where there could be in fact an even greater potential. Services are usually less capital intensive and moreover, usually more interfaced with direct customers.

Quite a bit has been discussed about public sector comparators. These are project models that are used in conjunction with PPP projects in order to be able to compare which financing alternative would be better from the public sector's viewpoint. This framework that was prepared for this paper shows that the comparator is perhaps not that necessary, or that at least it is not as difficult to construct as sometimes feared. Yes, there can and must be consideration whether the project is PPP or conventional, but in the end only the benefits against costs matters. If public sector can provide the same project effortlessly through its budget and in particular if the project generates a great deal of socio-economic benefits, there are few arguments for PPP. And on the other hand, if the project is relying on market demand and real cash flows, where is the case for public investment or intervention?

REFERENCES

1 Alfen, H.W., Kalidindi, S.N., Ogunlana, S., Wang, S.Q., Abednego, M.P., Frank-Jungbecker, A., Jan, Y.A., Ke, Y., Liu, Y.W., Singh, L.B., and Zhao, G.F. (2009), *Public-Private Partnership in Infrastructure Development - Case Studies from Asia and Europe,* Scientific series of Chair Construction Economics, Bauhaus-Universität Weimar, Germany.

2 Araújo, S. and Sutherland, D. (2010), "Public-private partnerships and investments in infrastructure", Economics Department Working Papers No. 803, OECD.

3 Bitsch, F., Buchner, A., and Kaserer, C. (2010), "Risk, return and cash flow characteristics of infrastructure fund investments", Strauss, H. (Ed.), *Public and private financing of infrastructure. Evolution and economics of private infrastructure finance*, EIB Papers, volume 15, no. 1, European Investment Bank.

4 Brealey, R.A., Cooper, I.A., and Habib, M.A. (1996), "Using Project Finance to Fund Infrastructure Investments", *Journal of Applied Corporate Finance*, Volume 9, Number 3, Fall 1996, pp. 25-38.
5 Burger, P., and Hawkesworth, I. (2011), "How To Attain Value for Money: Comparing PPP and Traditional Infrastructure Public Procurement", *OECD Journal on Budgeting*, Volume 2011/1.
6 Cruz, C.O., and Marques, R.C. (2011), "Revisiting the Portuguese experience with public-private partnerships", *African Journal of Business Management* Vol.5 (11), pp. 4023-4032, 4 June.
7 Cuttatree, V., and Mandri-Perrott, C. (2011), *Public-Private Partnerships in Europe and Central Asia. Designing Crisis-Resilient Strategies and Bankable Projects*, The World Bank.
8 Engel, E., Fischer, R., and Galetovic, A. (2010), "The economics of infrastructure finance: Public-Private Partnerships versus public provision", Strauss, H. (Ed.), *Public and private financing of infrastructure. Evolution and economics of private infrastructure finance*, EIB Papers, volume 15, no. 1, European Investment Bank.
9 Estache, A., Ellis, J., and Trujillo, L. (2007), "Public-Private Partnerships in Transport", *Policy Research Working Paper 4436*, The World Bank, December.
10 Inderst, G. (2010), "Infrastructure as an asset class", Strauss, H. (Ed.), *Public and private financing of infrastructure. Evolution and economics of private infrastructure finance*, EIB Papers, volume 15, no. 1, European Investment Bank.
11 Leviäkangas, P. (2007), "Private finance of transport infrastructure projects – value and risk analysis of a Finnish shadow toll road project", *VTT Publications* 624, Espoo, Doctor of Technology thesis.
12 Leviäkangas, P. (2009), "Valuing meteorological information", *Meteorological Applications* 16: 315-323, Royal Meteorological Society.
13 Leviäkangas, P., and Hautala, R. (2009). "The benefits and value of meteorological information services – the case of Finnish Meteorological Institute", *Meteorological Applications* 16: 369-379, Royal Meteorological Society.
14 Leviäkangas, P., Nokkala, M., Rönty, J., Talvitie, A., Pakkala, P., Haapasalo, H., Herrala, M., and Finnilä, K. (2011), "Ownership and governance of Finnish infrastructure networks", *VTT Publications* 777, VTT Technical Research Centre of Finland, Espoo.
15 Leviäkangas, P., Wigan, M., and Haapasalo, H. (2013), "Financial anatomy of E4 Helsinki-Lahti shadow toll PPP-project", *Built Environment Project and Asset Management,* accepted, forthcoming.
16 Marin, P. (2009), "Public-private partnerships for urban water utilities: a review of experiences in developing countries", *Trends and Policy Options*, No.8, The World Bank.
17 Nokkala, M., Finnilä, K., Rönty, J., and Leviäkangas, P. (2011), "Financial performance of Finnish technical networks", *VTT Working Papers*: 163, VTT Technical Research Centre of Finland.
18 OECD (2008), *Public-Private Partnerships: In Pursuit of Risk Sharing and Value for Money*, OECD Publishing.
19 Posner, P., Ryu, S.K., and Tkachenko, A. (2009), "Public-Private Partnerships: The Relevance of Budgeting", *OECD Journal on Budgeting*, Volume 2009/1, OECD.

20 Tervonen, J., Ristikartano, J., and Sorvoja, S. (2010), *Specification of Road User Costs. Background report 2010,* Research reports of the Finnish Transport Agency 33/2010, Helsinki, 2010.
21 UNESCAP (2011), *A Guidebook on Public-Private partnership in Infrastructure*, United Nations Economic and Social Commission for Asia and the Pacific.
22 Uppenberg, K., Straus, H., and Wagenvoort, R. (Eds.) (2011), *Financing infrastructure. A review of the EIB 2010 Conference in Economics and Finance*, European Investment Bank, January 2011.
23 Wagenvoort, R., and de Nicola, C. & Kappeler, A. (2010), "Infrastructure finance in Europe: composition, evolution and crisis impact", Strauss, H. (Ed.), *Public and private financing of infrastructure. Evolution and economics of private infrastructure finance*, EIB Papers, volume 15, no. 1, European Investment Bank.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

INFLUENCE OF PROJECT MANAGEMENT MATURITY ON PROJECTS' COSTS

Dr. Seweryn Spalek, Silesian University of Technology, Poland
spalek@polsl.pl

ABSTRACT

Purpose: *The purpose of this paper is to demonstrate the link between reaching a certain level of Project Management Maturity by the company and its projects cost performance.*
Design/methodology/approach: *The world-wide study was conducted in order to measure the influence of the Project Management Maturity level on the cost of projects. The survey was questionnaire based. As a result 194 cases were analyzed.*
Findings: *We found that an increasing level of maturity in Project Management can have an influence on the reduction of costs of projects managed by the company. However, the strength of this influence depends on various factors which are discussed in the paper.*
Research limitations/implications: *Research limitations are mostly connected with a limited range of industries available. Thus, limited representation led to a restricted cross-comparative study.*
Practical implications: *Companies assess their maturity levels in Project Management. The findings of this paper demonstrate to them the potential benefits they can gain by increasing their maturity level.*
Originality/value: *There is a limited number of world-wide studies on Project Management Maturity in companies. Moreover, the studies examining the influence of a certain maturity level on projects' key performance indicators are limited to single case studies. Therefore, the paper fills an important gap of knowledge in that area.*

Keywords: Project Management, Maturity, PMM, Costs, Influence, Company.
Classification: Research paper

INTRODUCTION

Projects are run by an increasing number of companies. Moreover, the number of projects run by companies has increased as well. Such a situation creates many multi-project environments, thus (Spalek, 2012) the management of them is a complex issue. Therefore, companies try to estimate how good they are at managing their projects (Liang, Liu, Lin, & Lin, 2007) (Tarn, Yen, & Beaumont, 2002). They perform maturity assessments in the field of Project Management (Becker, Knackstedt, & Poppelbuss, 2009; Grant & Pennypacker, 2006; Tervonen, Alapiha, & Haapasalo, 2009). The results of such assessments lead them to potential room for improvement and, as a result, gain a higher level of maturity. However, the question arises whether the improvement in maturity reflects in an improvement in a project's outcomes? If so, to what extent? In this article, we try to answer that question and fill in the gap of knowledge in that particular area.

THE ISSUE OF THE INFLUENCE OF ORGANIZATIONAL MATURITY ON PROJECTS' OUTCOMES

There are a number of models that could be used to assess maturity in Project Management in a company. Hillson (2003) argues that the number of practically implemented models could be over forty. Among them we can distinguish (Khoshgoftar & Osman, 2009) OPM3, CMMI (Twaites, Collofello, & Zenzen, 2004) (Twaites, Collofello, & Zenzen, 2004) (Twaites, Collofello, & Zenzen, 2004) (Twaites, Collofello, & Zenzen, 2004), P3M3 (Manzil & Javed, 2007), PRINCE (Zhang, He, & Zhang, 2012), BPMM (J. Y. Lee, Lee, & Kang, 2007), and Kerzner's Project Management Maturity Model. However, there is a very limited body of research conducted in the area as to whether the improvement in maturity reflects in an improvement in companies' operations (Liu, Chen, Chan, & Lie, 2008; Wang, 2008). Furthermore, the impact on the project's outcomes is investigated in single case studies in the chosen aspects of managing projects (Belt, Oiva-Kess, Harkonen, Mottonen, & Kess, 2009; Jiang, Klein, & Pick, 2003; Lee, Lin, & Pai, 2005). There is a significant gap in research on the correlation between Project Management maturity and projects' outcomes. The reason for this situation could be that (1) it is hard to determine the impact as the issue is multidimensional and (2) the commonly used Project Management Maturity models are adequate for the assessment of maturity in a case-studies approach, while in comparative studies they are hard to apply.

Therefore, in this article we try to advance the current state of knowledge by investigating the influence of Project Management Maturity on projects' costs.

RESEARCH DESIGN

This research was part of a wider international study sponsored by the *National Science Center*, whose purpose was to investigate Project Management Maturity in the chosen companies and its implications. In order to perform the comparative study among the companies, we built a maturity model which was used in the assessments (from level 1-the lowest, to 5-the highest) in a number of companies, mainly from the machinery industry. The study was questionnaire-based and was performed both online and also by using a traditional approach. The research instrument was validated by experts in the field. As a result, 447 samples were gathered, representing companies from a variety of countries. Among those companies, the ones reporting a maturity level of at least 2 were chosen. Their experts responded to the questions regarding the potential impact of maturity in Project Management on projects' outcomes. In this article, we will focus on the issue of cost only. The number of validated and analyzed data samples for that purpose is 194. Cronbach's Alpha tests confirmed the reliability of data reporting values over 0.97.

The respondents were to choose the impact of change in the maturity level on forthcoming projects in terms of cost. They ought to consider the change in maturity in the following areas: (1) Human Resources, (2) Methods, (3) Environment and (4) Knowledge Management. Furthermore, they were supposed to estimate the potential impact of the change in maturity in each area by one level up on forthcoming projects. The level of impact was described as follows; 1: No influence, 2: 1-10%, 3: 11-20%, 4: 21-30%, 5: over 30% on projects' costs reduction. The change in maturity was considered to be one of the following types: from 1 to 2 (1-2), from 2 to 3 (2-3), from 3 to 4 (3-4) and from 4 to 5 (4-5). The scale of maturity

levels was formed based on the framework proposed in the wider context of overall studies and is described as follows: LEVEL 1 - *Initial*, LEVEL 2 - *Standardized*, LEVEL 3 - *Appliance*, LEVEL 4 - *System Management*, LEVEL 5 - *Self-improvement* . The scheme of measuring impact is shown in figure 1.

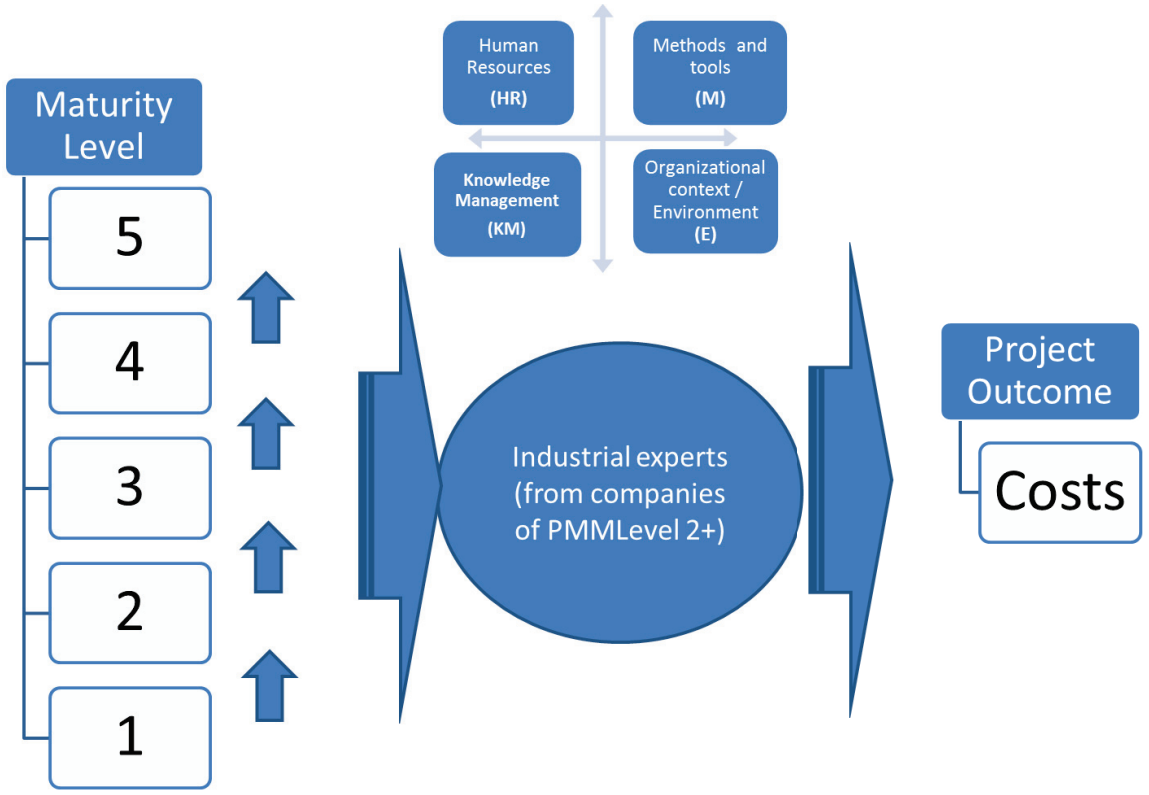


Figure 1. The scheme of measuring the impact of change in maturity on the project costs

RESULTS AND DISCUSSION

The companies chosen to be investigated in the paper were from a broad range of countries (N=19). Among them, most companies (80,2%) were located in: Germany, Denmark, USA, Sweden, Switzerland, Italy and Finland. Some companies came from: Austria, France, UK, India, Iran, Japan, Australia, Morocco, Russia, Slovenia, Slovakia and Lithuania. They represented three types of industries: Machinery Industry (IND), Information Technology (IT) and Construction (CONS). Moreover, in our work, we focused on each of those groups separately according to the impact of Project Management maturity on the projects' costs. Furthermore, we conducted cross-industrial studies in each of the investigated maturity areas: (1) Human Resources, (2) Methods, (3) Environment and (4) Knowledge Management.

The construction branch (CONS) reported some influence of changing the maturity level up on the projects' outcome. However, the level of influence depended on the change type (1-2, 2-3, 3-4, 4-5). The highest average impact (3.6) was noticed in the changes in maturity of types 1-2 and 2-3 in the area of Human Resources (HR). It then decreased to 2.85 and 2.10 for types 3-4 and 4-5 respectively.

In the area of Methods (M), the impact reported the same level of 3.6 for change types of 1-2 and 3-4. It then also decreased to level 2.85 and 2.10 for types 3-4 and 4-5 accordingly.
In the Environment (E) and Knowledge Management (KM) areas, the results were the same and, for types 1-2 and 2-3, the impact on projects' costs was 2.85 and further declined to 2.10 (3-4), finally settling at level 1.5 (4-5).

The machinery industry branch (IND) reported slightly lower influences. However, a downward trend was also observed in all areas of maturity (HR, M, E and KM).

The average impact of 3.46 was noticed for maturity change type 1-2 and 2-3 in the Human Resources area (HR). An impact level of 2.74 and 2.02 was reported for change type of 3-4 and 4-5 respectively. In the methods area (M), the results were the same as for the Human Resources area.

Furthermore, in the areas of Environment (E) and Knowledge Management (KM), reported influences were at the same level. Furthermore, they showed an average value of 2.74 for 1-2 and 2-3 types of changes and, for 3-4 and 4-5, it decreased respectively from 2.02 to 1.46.

The Information Technology (IT) branch reported a different structure of influences than in the above-stated Machinery Industry (IND) and Construction (CONS). As opposed to IND and CONS, there were no significant differences in impacts between the four areas in IT. However, the impact level also reported a downward trend over the types of maturity changes. For the change types of 1-2 and 2-3, the average impact was 3.62 in Human Resources and (HR) and Methods (M), while, in Environment (E) and Knowledge Management (KM), it was 3.59. For 3-4 and 4-5, the impact decreased to 2.87 and 2.13 in the Human Resources and (HR) and Methods (M) areas while, in Environment (E) and Knowledge Management (KM), it declined to 2.85 and 2.13 respectively.

The cumulative data chart of the average influences of the changes resulting from one level up in maturity, in specific areas, on project costs is shown in table 1.

Table 1. The average influences of the change in maturity on project costs; (HR) Human Resources, (M) Methods, (E) Environment, (KM) Knowledge Management.

Group Statistics						
BRANCH	**Maturity change**	**N**	**HR**	**M**	**E**	**KM**
CONS	1-2	48	3.6	3.6	2.85	2.85
	2-3	48	3.6	3.6	2.85	2.85
	3-4	48	2.85	2.85	2.1	2.1
	4-5	48	2.1	2.1	1.5	1.5
			HR	M	E	KM
IND	1-2	107	3.46	3.46	2.74	2.74
	2-3	107	3.46	3.46	2.74	2.74
	3-4	107	2.74	2.74	2.02	2.02
	4-5	107	2.02	2.02	1.46	1.46
			HR	M	E	KM
IT	1-2	39	3.62	3.62	3.59	3.59
	2-3	39	3.62	3.62	3.59	3.59
	3-4	39	2.87	2.87	2.85	2.85
	4-5	39	2.13	2.13	2.13	2.13

The main purpose of this article was to investigate potential influences of Project Management Maturity change on the projects' costs. We pointed out some dependencies in relation to: (1) branch, (2) area of maturity and (3) type of maturity change. That was, we believe, the first step toward the more advanced data analysis, including factor analysis, in order to determine the correlations between the specific factors and recognize their groups.

CONCLUSIONS

The issues discussed in this paper were to answer the research question whether an improvement in maturity reflects in an improvement in projects' outcomes. The presented results of the research showed that an influence on costs (one of the project outcomes) exists. However, we recognized that the influence varies: (1) among the industries, (2) in specific maturity areas and (3) in relation to the type of maturity change.

We discovered some similarities between the Construction and Machinery industries. Their results were alike regarding (1) level of influence in specific maturity areas (Human Resources, Methods, Environment and Knowledge Management) and (2) level of influence caused by different types of change of maturity (from level 1 to level 2 (1-2), from level 2 to level 3 (2-3), from level 3 to level 4 (3-4) and from level 4 to level 5 (4-5)). Both branches reported similar influence levels in the Human Resources & Methods areas and Environment & Knowledge Management areas.

While the Information Technology industry reported only the influence caused by different types of change of maturity. There were no significant differences in the influence in specific maturity areas.

It is remarkable that all branches reported a drop in influence with the type of change in maturity. The biggest influence was always reported for the maturity change 1-2 and 2-3 and then it decreased through 3-4 to 4-5, irrespective of the specific maturity area. This observation leads to the conclusion that the efforts in increasing maturity levels from *initial* to s*tandardized*, and from s*tandardized* to *appliance,* is of the highest potential average impact on the projects' costs reduction (up to 30%). Further efforts to improve maturity from *appliance* to s*ystem management* and from s*ystem management* to *self-improvement* result in a lower average potential impact on costs reduction (up to 20%).

ACKNOWLEDGMENTS

This work was supported by the National Science Center grant.

REFERENCES

1. Becker, J., Knackstedt, R., & Poppelbuss, J. (2009), "Developing Maturity Models for IT Management - A Procedure Model and its Application", *Business & Information Systems Engineering*, 1(3), 213-224.
2. Belt, P., Oiva-Kess, A., Harkonen, J., Mottonen, M., & Kess, P. (2009), "Organisational Maturity And Functional Performance", *International Journal of Management and Enterprise Development*, 6(2), 147-164.
3. Grant, K. P., & Pennypacker, J. S. (2006), "Project Management Maturity: An Assessment Of Project Management Capabilities Among And Between Selected Industries", *IEEE Transactions on Engineering Management*, 53(1), 59-68.
4. Hillson, D. (2003), "Assessing Organizational Project Management Capability", *Journal of Facilities Management*, Vol 2, No 3, PP 298-311.
5. Jiang, J. J., Klein, G., & Pick, R. A. (2003), "The Impact Of IS Department Organizational Environments Upon Project Team Performances", *Information & Management*, 40(3), 213-220.
6. Khoshgoftar, M., & Osman, O. (2009), *Comparison of Maturity Models*, New York: IEEE.
7. Lee, G. G., Lin, H. F., & Pai, J. C. (2005), "Influence Of Environmental And Organizational Factors On The Success Of Internet-Based Interorganizationai Systems Planning", *Internet Research*, 15(5), 527-543.
8. Lee, J. Y., Lee, D. Y., & Kang, S. W. (2007) , "An Overview of the Business Process Maturity Model (BPMM) ", *Advances in Web and Network Technologies, and Information Management, Proceedings*, 4537, 384-395.
9. Liang, T.-P., Liu, C.-C., Lin, T.-M., & Lin, B. (2007). Effect of team diversity on software project performance. Industrial Management & Data Systems, 107(5-6), 636-653.
10. Liu, J. Y. C., Chen, V. J., Chan, C. L., & Lie, T. (2008), "The Impact Of Software Process Standardization On Software Flexibility And Project Management Performance: Control Theory Perspective", *Information and Software Technology*, 50(9-10), 889-896.

11. Manzil, E. M., & Javed, T. (2007) , "Practicum In Software Project Management - An Endeavor To Effective And Pragmatic Software Project Management Education", *Proceedings of the 4th IASME/WSEAS International Conference on Engineering Education*, 103-112.
12. Spalek, S. (2012) , "The Role Of Project Management Office In The Multi–Project Environment", *International Journal of Management and Enterprise Development*, 12(2), 172-188.
13. Tervonen, P., Alapiha, J., & Haapasalo, H. (2009) , "Benchmarking ESSQ Management System Through Tailored Maturity Model", *International Journal of Management and Enterprise Development*, 7(3), 262-280.
14. Tarn, J. M., Yen, D. C., & Beaumont, M. (2002), "Exploring the rationales for ERP and SCM integration", *Industrial Management & Data Systems*, 102(1-2), 26-34.
15. Twaites, G., Collofello, J., & Zenzen, F. (2004) , "The CMMI - More Than Just Process", *Tenth ISSAT International Conference on Reliability and Quality in Design, Proceedings*, 309-314.
16. Wang, H. F. (2008), *Capability Maturity Model For Risk Management In ERP/ERPII Implementation Project*, Toronto: Universe Academic Press Toronto
17. Zhang, L. Y., He, J., & Zhang, X. X. (2012) , "The Project Management Maturity Model and Application Based on PRINCE2", *2012 International Workshop on Information and Electronics Engineering*, 29, 3691-3697.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

BUSINESS MODELS IN CONSTRUCTION – CONSTRUCTION MANAGERS' VIEWPOINT

Aki Pekuri, Department of Industrial Engineering and Management, University of Oulu, Finland
Email: aki.pekuri@oulu.fi

Laura Pekuri, Department of Industrial Engineering and Management, University of Oulu, Finland
Email: laura.pekuri@oulu.fi

Harri Haapasalo, Department of Industrial Engineering and Management, University of Oulu, Finland
Email: harri.haapasalo@oulu.fi

ABSTRACT

Business model – nowadays, in other sectors a widely used managerial practice for designing, comparing, and analysing the value creation logic of an organization – is a less discussed and researched concept in the field of construction. Current business model literature sees the concept as an essential part of successful business as its main purpose is to separate a company from the others and to give it an advantage in regard to its competitors. A business model defines the way company operates, how it creates value for its customers and how it captures value from its operations to make profit. Thus it forces managers to think about their business and how it functions as a whole. Recent developments in this field of research have also led to visualizing business models, resulting a better understanding of different business logics and a position where business models are used as an effective management tool to communicate and execute strategy.

The aim of this research is to explore the way how construction managers understand and use business models. Research is based on ten semi-structured interviews conducted in Northern Finland between February and March 2013. Respondents have a vast amount of experience from the construction business and act in chief executive or regional manager positions in their companies which size varied from small to large. In addition, company websites and other publicly available materials are used in formulating an understanding about the logics according to which these construction companies operate.

According to the results, construction managers understand business models very differently than what is accustomed in other sectors or within the academia. The main difference is that they relate these models to different project delivery and contract types such as housing development, design-build, and design-bid-build. The outcome of business model analysis is thus more a certain figure describing a desired level for return on investment rather than an analysis of what the actual customer needs are and how value could be created for the

customers. Another finding is that the most of the prevailing business models in construction have no significant differences which results in a fierce price competition where companies provide exactly the same value through mostly uniform activities and structures.
The results have several implications for both theory and practice. First of all, research in the field of construction business models is under developed and the current theory is unable to guide and inspire the construction managers, who operate mainly in local old-fashioned business where market volatility is remarkable, to challenge their prevailing business models Another theoretical implication is the concept's connection with different project delivery and contract types. Practical implications are provided by elaborating the theoretical viewpoint of business models and presenting examples of how different business logics can prove valuable also in construction. The research is valuable both for researchers, who should find new avenues for future research from the study, and for practitioners, who want to challenge the traditional business models in construction.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THREAT OF INSOLVENCY OF PRIVATE SECTOR COMPANIES ON THE EXAMPLE OF POLAND, CZECH REPUBLIC AND SLOVAKIA

Dr hab. Justyna Franc-Dąbrowska, Warsaw University of Life Science
Email: justyna_franc_dabrowska@sggw.pl

Dr Małgorzata Porada-Rochoń, University of Szczecin
Email: malgorzata.rochon@wp.pl

ABSTRACT

Introduction: *Changeability of environment causes that companies are more often vulnerable to functioning in a crisis. Managers around the world identify liquidity management as the primary driver of their decisions. In the turbulent environment in times of financial crisis, liquidity becomes more difficult but also more important. Especially since the crisis leads to erosion of liquidity and even insolvency. Many researches examine the phenomenon of the lack of liquidity taking into consideration different perspective. Therefore, it is important to study the phenomenon of insolvency, determinants that shape it as well as seek opportunities to reduce the risk of this problem.*

Research methodology: *The aim of the study was to identify the determinants that affect the risk of insolvency of companies in Poland, Czech Republic and Slovakia in the conditions of instability of the economies in these countries. Panel data analysis was carried out – panels balanced in 2006-2010. The study involved 256 companies from Poland, 388 from Czech Republic and 187 from Slovakia. In the first stage of the research panel model was developed for Poland using fixed-effects panel analysis. Fixed-effects panel analysis in the following form was used:*

$$y_{it} = x_{it}\beta + u_i + \varepsilon_{it}$$

where u_i *- individual effect,*

ε_{it} *- pure random error.*

In the fixed-effects panel model fixed individual effects are eliminated by averaging the model against time (t_{index}*). Explanatory variable was shareholders funds, among the variables under consideration were 15 variables (metrics and financial ratios), which underwent initial substantive and statistical verification. The starting point of the analysis were shareholders funds, because under conditions of financial instability, there are shareholders funds that protect businesses against the risk of insolvency. In the second stage of the study variables specific for Polish companies were analyzed and compared with data from Czech and Slovak companies, using non-parametric Kolmogorov-Smirnov tests. An interesting research problem is the fact whether the companies in Central Europe show similarities in the variables that determine the level of shareholders funds and if the same actions (or*

similar) preventing the threat of insolvency can be recommended to companies from different countries.

The results of literature research: *The identified factors can be divided into two groups: variables having nature of assets/equity and cost related variables. The results of the model allowed to confirm statements known from finance literature that an important factor in supporting the operation of enterprises in a long time are loans and they do not necessarily have to be criticized (especially in terms of the costs associated with the use of this source of capital). Long-term loans may in fact be the one factor that not only allows the company to continue, but also allows the development to a greater extent than it would be possible only on the basis of equity. The variable that assists in this process are tangible fixed assets, which also positively influence the level of shareholders funds and therefore protect Polish companies against the threat of becoming insolvent.*

Variables negatively affecting levels of shareholders funds in Polish enterprises in 2006-2010 were material costs and depreciation. From the point of view of the stability of the financial situation of enterprises and opportunities to reduce the risk of insolvency these two variables should be particularly closely monitored by management. It has its source among others in overinvesting in some of Polish companies and limited possibilities of full capacity utilization during stagnation of the economy.

The model was subject to substantive and formal verification and it was found it was valid. In the second stage of the research a comparative analysis of businesses in Poland Czech Republic and Slovakia will be carried out, conclusions will be drawn regarding the companies analyzed in these three countries, as well as the findings of the research will be formulated. The paper will also include recommendations for entrepreneurs in Poland, Czech Republic and Slovakia.

INTRODUCTION

Changeability of environment causes that companies are more often vulnerable to functioning in a crisis. Managers around the world identify liquidity management as the primary driver of their decisions. In the turbulent environment in times of financial crisis, liquidity management becomes more difficult but also more important. Especially since the crisis leads to erosion of liquidity and even insolvency. Many researches examine the phenomenon of the lack of liquidity taking into consideration different perspective. Therefore, it is important to study the phenomenon of insolvency, determinants that shape it as well as seek opportunities to reduce the risk of this problem.

Since 2007, in economic literature on finance, significant attention has been paid to the changes and effects of the macroeconomic environment on business failure and company insolvency. Indeed, in times of crisis, the number of unsuccessful companies is higher, than in times of economic prosperity.

The crisis from 2007-2008 affected mostly micro small and medium companies, which faced financial spiral downturn that often drove them to bankruptcy. Due to the fact, that current crisis increased number of bankruptcies and insolvencies[1], financial management is gaining importance in the context of preventing or diminishing its impact. Therefore, the study of determinants influencing this phenomenon is valuable. The more extensive analysis and knowledge of the determinants shaping insolvency, the more likely possibility of eliminating it, which also matters for the health of whole economy.

RESEARCH METHODOLOGY

The aim of the study was to identify the determinants that affect the risk of insolvency of companies in Poland, Czech Republic and Slovakia in the conditions of instability of the economies in these countries. Panel data analysis was carried out – panels balanced in 2006-2010. The study involved 256 (panel 1287) companies from Poland, 388 (panel 1940) from Czech Republic and 187 (panel 935) from Slovakia. In the first stage of the research panel model was developed for Poland using fixed-effects panel analysis. Fixed-effects panel analysis in the following form was used:

$$y_{it} = x_{it}\beta + u_i + \varepsilon_{it}$$

where y_{it} – endogenous variable,

x_{it} – exogenous variable (generally a vector of exogenous variables),

u_i – individual effect,

ε_{it} – pure random error (Kufel 2007).

In the fixed-effects panel model fixed individual effects are eliminated by averaging the model against time (t index). Explanatory variable was shareholders funds, among the variables under consideration were variables: metrics and financial ratios, which underwent initial substantive and statistical verification. In addition, variability in the data over time (dt_2-dt_5) has been also included. The starting point of the analysis were shareholders funds, because under conditions of financial instability, there are shareholders funds that protect businesses against the risk of insolvency. In the second stage of the study variables specific for Polish companies were analyzed and compared with data from Czech Republic and Slovak companies, using Kruskal-Wallis tests. An interesting research problem is the fact whether the companies in Central Europe show similarities in the variables that determine the level of shareholders funds and if the same actions (or similar) preventing the threat of insolvency can be recommended to companies from different countries.

Determinants of insolvency – literature review

Generally, solvency means ability to pay current debt. The ability to pay debt is conditioned by assets and capital structure. Leverage is defined as the sensitivity of the value of equity ownership with respect to changes in the underlying value of the firm. Leverage ratios are frequently independent variables. Leverage ratios are also the dependent variable in the empirical capital structure literature. This literature tries to explain variations in corporate

[1] Interesting results and the extent of phenomenon presents: BUSINESS DYNAMICS:START-UPS, BUSINESS TRANSFERS AND BANKRUPTCY 2011 published by European Commission.

leverage, both in the cross section of capital structure (i.e. why some companies have high leverage) and in the time series (how capital structures evolve). In the theory of capital structure, one common hypothesis derives directly from the equity-sensitivity channel: a company with more leverage has both higher powered incentives and (usually) a higher probability of financial distress (Welch 2011).

It should be taken into consideration, that, according to the tradeoff theory, the capital structure literature finds a negative relationship between profitability and leverage. Branch (2000) and Campbell and Frost (2007) argue that when a company is in financial distress, managers have a fiduciary duty to protect the rights of creditors as well as duties to shareholders. Therefore, in a financially distressed company, we assume that the payoff for the manager depends on both the value of equity and debt.

Also it is important to take into account the impact of financial flexibility on capital structure. The literature presents a vast array of research on insolvency, thus pointing to a number of different, sometimes conflicting factors that determine it.

According to assets liquidity in terms of distress companies, interesting findings are presented by Shleifer and Vishny (1992). They argue that when companies have trouble meeting debt payments and sell assets, the highest valuation potential buyers of these assets are likely to be other firms in the same industry. But with the possibility of a contagion effect, these firms themselves are likely to have trouble meeting their debt payments. Bhagat et al. (2005) considered decision of distress companies related to cash flow and financial results. They found negative investment-cash flow sensitivity for distressed firms with operating losses and a positive sensitivity for all other firms. At the same time, they document that the negative cash flow sensitivity is generated by distressed firms with operating losses that invest more than the previous years (in : Flagg, Kudrimoti, Margetis 2011). It means, that due to the trend toward declining cash flow, these companies make decisions to increase their investments (Flagg, Kudrimoti, Margetis 2011).

Researches carried by Altman (1984), Alderson and Betker (1995), Andrade and Kaplan (1998), Molina (2005), point out, that management of trade receivables, given its importance for firms' assets, has the potential to play important role when firms encounter financial problems (especially according to estimation of the costs of financial distress, in some cases explicitly recognizing the importance of the relations with clients for capital structure decisions and for the costs of financial distress (Titman 1984, Opler, Titman 1994). (Molina, Preve 2009).

Preve and Molina (Molina, Preve 2009) undertook the study to clarify the trade receivable policy, depending on the stage of financial distress proved. They document that, firms in financial distress tend to increase the use of trade receivables when they start facing profitability problems, usually in a prefinancial distress situation and provide fewer trade receivables to their clients when they face cash flow problems and enter full financial distress. According to financial condition of companies in financial distress, they investigated the effect of decrease in trade receivables. The results were consistent with those presented in the literature, but they add to this body of knowledge by demonstrating that the drop is significantly larger when there is a reduction in trade receivables (Molina, Preve 2009).

Long-term solvency is concerned with two important elements: capital structure and earning power. “Capital structure refers to the sources of financing for a company. Financing can range from relatively permanent equity capital to more risky or temporary short-term financing resources” (Wild et al. 2007 in Bardia 2012).

The issue of equity returns in terms of financial distress, as well as default probability is presented by Avramov et al. (2007). They indicate that profits of momentum strategies that buy “winners” and sell “losers” are remarkably concentrated among a small subset of firms with low credit ratings, which adds a new dimension to the complex relationship between financial distress and cross-sectional properties of equity returns. Thus, the hump-shaped relationship between expected returns and default probability is capable of simultaneously explaining two known empirical regularities: the inverse relationship between expected returns and default probability (Dichev (1998), Campbell et al. (2008), Garlappi et al. (2008), and George and Hwang (2010)), and the concentration of momentum profits in low credit quality stocks (Avramov et al. (2007)) (Chou at al 2010).

Adopting the general determinants influencing the threat of insolvency can be replaced (Damodaran 2009 and others):
1. **Stagnant or declining revenues**: one of the first sign of a company in decline is inability to increase revenues over extended periods, even if a company operates in normal economical circumstances . Flat revenues or revenues that grow at less than the inflation rate indicate operating weakness.
2. **Shrinking or negative margins**: together with stagnant revenues at declining firms shrinking operating margins can be also observed, which is partly due deteriorating pricing power and partly because they decrease prices to preserve revenues from further drop. Instead of getting better, their financial condition is worsening. This results together in deteriorating or negative operating income at these firms, with occasional increases in profits generated by asset sales or one-off profits.
3. **Asset divestitures**: the deterioration of the financial situation of the company, including in particular the lack of liquidity makes it necessary to raise extra cash. Assets divestiture can help companies to recover and improve (increase) the level of liquid assets). If a declining firm has significant debts, it will be more determined to sell assets to avoid default or to pay down debt.
4. **Big payouts** – dividends and stock buybacks: Firms with problems don’t have typically investments that generate value, existing assets that may can generate positive cashflows and disposal of assets that result in cash inflows. In financial distress, when there is lack of cash (also no positive financial results), sometimes companies instead of paying dividends, they prefer to offer stock.
5. **Financial leverage** – the more debt in financial structure, the higher risk of default. Having stagnant and falling earnings from existing assets and little potential for earnings growth, many declining firms face difficult debt burdens. Such situation creates a risk of gridlock payment, which entails increased distrust form stakeholders point of view. At the same time, capital providers at least demand more collateral, thereby creating even the ground for bankruptcy.

For above reasons, to explain the phenomenon of default in our study, we used an independent variable: equity. Our findings show, that there is an interesting combination of factors defining independent variable.

RESULTS OF EMPIRICAL RESEARCH

The identified factors can be divided into two groups: variables having nature of assets/equity and cost related variables. The results of the model allowed to confirm statements known from finance literature that an important factor in supporting the operation of enterprises in a long time are loans and they do not necessarily have to be criticized (especially in terms of the costs associated with the use of this source of capital). Long-term loans may in fact be the one factor that not only allows the company to continue, but also allows the development to a greater extent than it would be possible only on the basis of equity. The variable that assists in this process are tangible fixed assets, which also positively influence the level of shareholders funds and therefore protect Polish companies against the threat of becoming insolvent.

Variables negatively affecting levels of shareholders funds in Polish enterprises in 2006-2010 were material costs and depreciation. From the point of view of the stability of the financial situation of enterprises and opportunities to reduce the risk of insolvency these two variables should be particularly closely monitored by management. It has its source among others in overinvesting in some of Polish companies and limited possibilities of full capacity utilization during stagnation of the economy. In addition, it should be kept in mind that depreciation is one of those cost factors that in case of companies heavily equipped with fixed assets can greatly affect financial result, thus directly impacting level of retained earnings and thus equity. On the other hand, in innovative economy, it is spot-on investments may allow companies not only exist on the market in financial crisis or stagnation of the economy but may also help to achieve a competitive advantage and, therefore, growth. It is not recommended, therefore reducing the level of depreciation (e.g. at the expense of investments), but a critical analysis of the actual investment needs of enterprises. The situation is similar in case of the costs of raw materials for production. As an important component of costs they have clear influence on the reduction of the net financial result and, therefore, retained earnings (which in turn reduces the level of equity). On the other hand, the search for a niche market in the area of high (or so far offered) quality requires ensuring good quality (or so far offered) raw materials for production. It is recommended, therefore, a critical analysis of costs of raw materials and exploring the possibilities of reducing such by eliminating losses, negotiating prices and terms of delivery.

Table 1. Estimation results of the panel analysis – fixed-effects panel model, private sector companies of Poland

Model: Panel estimation – method fixed-effects panel model Dependent variable: log_ Shareholders funds thousand EUR Resistant standard errors (robust HAC)					
Variable	Coefficient	Standard error	*t*-Student	*p-value*	Significance
Const	-0,0929588	0,247154	-0,3761	0,71398	
l_Tangible_fixed_assets_th_EUR	0,07306	0,00726313	10,0590	<0,00001	***
l_Other_shareholders_funds_th_EUR	0,810503	0,012694	63,8492	<0,00001	***
l_Long_term_debt_th_EUR	-0,00137832	0,00859232	-0,1604	0,87546	
l_Creditors_th_EUR	0,0352723	0,0050946	6,9235	0,00003	***
l_Net_current_assets_th_EUR	0,0328687	0,00839009	3,9176	0,00240	***
l_Number_of_employees	-0,0971961	0,03957	-2,4563	0,03189	**
l_Full_financial_expense	0,0568231	0,0224946	2,5261	0,02817	**
l_Taxation_th_EUR	0,000613436	0,00322323	0,1903	0,85253	
l_Material_costs_th_EUR	-0,0486917	0,00697283	-6,9831	0,00002	***
l_Costs_of_employees_th_EUR	0,170911	0,0680679	2,5109	0,02894	**
l_Depreciation_th_EUR	0,108837	0,0174036	6,2537	0,00006	***
l_Interest_paid_th_EUR	-0,0597064	0,0155374	-3,8428	0,00273	***
dt_2	-0,0121127	0,0180436	-0,6713	0,51588	
dt_3	-0,0303302	0,0226282	-1,3404	0,20715	
dt_4	-0,056574	0,0287884	-1,9652	0,07515	*
dt_5	-0,0681735	0,0419602	-1,6247	0,13250	
Coefficient of determination R^2 = 0,999797					
Statistics F (58, 11) = 932,6853, p-value < 2,83e-15					
Doornik-Hansen test Chi-square 6,39714, p-value = 0,0408205					

* significant at the 10 percent level, ** significant at the 5 percent level, *** significant at the 1 percent level.

Source: own work.

The model was subject to substantive and formal verification and it was found it was valid. In view of the high level of coefficient of determination R^2, critical analysis of model has been conducted looking for a explanatory variable / variables that would be a duplication of data of dependent variable. Not found to occur such variables. Verification elimination of variables: I_Other_shareholders_funds_th_EUR and I_Full_financial_expense, resulted only in a

reduction in the level of Coefficient of determination R^2 only to a level significantly above 0.98, and also resulted in a significant deterioration of model parameters in the normal distribution of residuals. It was therefore concluded that these variables are not factors artificially enhancing model, but their absence causes deterioration of the quality of the model. In the second stage of the research a comparative analysis of businesses in Poland Czech Republic and Slovakia will be carried with the use of multiple comparisons (Kruskal-Wallis test).

Table 2. shows the results of the multiple comparisons - Kruskal-Wallis test. Null hypothesis has been formulated: variables specific to the Polish model do not differ from the corresponding variables characterizing the financial situation of small and medium-sized enterprises in Czech Republic and Slovakia. It was decided that the variables specific to Polish companies (at least some of them) may be similar in enterprises in Czech Republic and Slovakia (due to a similar geographical location, a similar level of economic development, and also bearing in mind historical changes in these countries).

Table 2. Results of multiple comparison - Kruskal-Wallis test for selected variables of private sector companies in Poland, the Czech Republic and Slovakia

Variable	Companies - Poland	Companies - Czech Republic	Companies - Slovakia
Tangible fixed assets thous. EUR	Yes	Yes	Yes
Other shareholders funds thous. EUR	Yes	Yes	Yes
Long term debt thous. EUR	Yes	Yes	Yes
Creditors thous. EUR	**No**	**No**	Yes
Net current assets thous. EUR	Yes	Yes	Yes
Number of employees	Yes	Yes	Yes
Full financial expense	Yes	Yes	Yes
Taxation thous. EUR	Yes	Yes	Yes
Material costs thous. EUR	Yes	Yes	Yes
Costs of employees thous. EUR	Yes	Yes	Yes
Depreciation thous. EUR	Yes	Yes	Yes
Interest paid thous. EUR	**No**	**No**	Yes

Source: own work.

The analyzes conducted lead to the conclusion that in comparable countries, there is a statistically significant variation of selected variables in the period 2006-2010 and therefore the null hypothesis should be rejected. Only two variables: Creditors thous. EUR and Interest paid showed no significant differences between firms engaged in economic activities in the two countries: Poland and the Czech Republic. However, there was no similarity between the variables in relation to Slovak companies. Therefore, it should be noted that despite some similar features for small and medium-sized enterprises operating in Poland, the Czech Republic and Slovakia, individualized analysis and separate models should be developed for each country. Therefore, analysis started in this study will form the basis for further research distressed entities of private sector in Czech Republic and Slovakia. The preliminary results of model of insolvency risk of Czech companies show that in addition to the variables specific to the Polish model (Table 1), a statistically significant variable is the cash flow (th

EUR). These studies, however, require further deepening, and in this study they will not be continued.

FINDINGS OF RESEARCH

Given the need to identify risk factors for private sector insolvency it was found that in addition to the variables characterizing the capital structure, particular attention should be paid to the variable cost, such as depreciation and cost of raw materials. It is important also to perform a critical review of existing and planned investments, costs incurred for production, as well as exploring the possibilities of reducing them (through the elimination of losses, negotiating prices and terms of delivery).

CONCLUSIONS

Economic instability of economies in many countries indicates the need to look for risk factors for private sector insolvency. Despite some close historical and geographical circumstances, it is not obvious that the same factors and to the same extent, influence the risk of insolvency of companies in Poland, Czech Republic and Slovakia. The importance of this threat of insolvency in private sector is so high that it requires further, in-depth research that will be continued.

ACKNOWLEDGEMENT

This research is a part of project financed by the National Science Centre granted on the basis of the decision DEC-2011/03/B/HS4/05503

REFERENCES

1. Bardia S. C., Predicting Financial Distress and Evaluating Long-Term Solvency: An Empirical Study.
2. Bhagat, S., N. Moyen and I. Suh (2005), Investment and internal funds if distressed firms, Journal of Corporate Finance 11: 449-472.
3. Branch B. (2000), Fiduciary duty: Shareholders versus creditors, Financial Practice and Education, 10(2): 8-13.
4. Business Dynamics: Start-Ups, Business Transfers And Bankruptcy (2011), published by European Commission.
5. Campbell R, Frost CW (2007) Managers' fiduciary duties in distressed corporation: chaos in Delaware and elsewhere. J Corp Law Spring: 492–525.
6. Chou S., Su E., Li S., Cheng H., An Empirical Study of the Relationship Between Corporate Information Disclosure and Financial Distress, International Research Journal of Finance and Economics, ISSN 1450-2887 Issue 43 (2010), pp. 141-155.
7. Damodaran A., Valuing Distressed and Declining Companies, Stern School of Business, June (2009), Electronic copy available at http://ssrn.com/abstract=1428022.
8. Flagg, Kudrimoti , Margetis Do Management Decisions Matter When Firms Are In Distress? Review Of Management Innovation & Creativityrmic - Volume 4, Issue 9 (2011), pp. 1-19.
9. Kufel T. (2007), Ekonometria. Rozwiązywanie problemów z wykorzystaniem programu GRETL, Wydawnictwo Naukowe PWN, Warszawa.

10. Molina Carlos A., Preve Lorenzo A., Trade Receivables Policy of Distressed Firms and Its Effect on the Costs of Financial Distress, Financial Management, Autumn (2009), pp. 66-686.
11. Shleifer, A. and R. W. Vishny (1992), Liquidation Values and Debt Capacity: A Market Equilibrium Approach, Journal of Finance 47(4): 24.
12. Welch Ivo, Two Common Problems in Capital Structure Research: The Financial- Debt-To-Asset Ratio and Issuing Activity Versus Leverage Changes, International Review of Finance, 11:1, (2011): pp. 1–17.
13. Wild John J., Subramanyam K. R. and Halsey R. F. (2007), Financial Statement Analysis, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE SELECTION OF PROJECT IN RAPID ENVIRONMENT'S INDUSTRY USING ZERO BASED BUDGET

Supachart Iamratanakul, Kasetsart University, Thailand
supachart9@gmail.com

ABSTRACT

Purpose: *The strategic selection of projects deals with the determination of a strategic fit and prioritization. The impact of the project selection process obviously shows on the future profits and growth of an organization. Since the organization is much relied on that growth, this study is initiated to present the case study that the projects can set the plan to prioritize and allocate the resource of an organization.*
Design/methodology/approach: *The budgeting method i.e. "the Zero Based Budget (ZBB)" can be a tool to prioritize projects and allocate those scare resources to the project at the top list.*
Findings: *The article shows the case study of a company from a rapid environment's industry that needs fast development in their projects. The case provide lesson learn that a technology company should practice the six steps process to maximize their project contributions and deliver results using all available resources.*
Originality/value: *The article shows the key to success for practicing good prioritization for project management at high technology companies. The practical guidelines of Zero Based Budget (ZBB) are also useful for selecting projects.*

Keywords: project selection; strategic fit; prioritization; project management; Zero Based Budget (ZBB)
Classifications: Research paper

INTRODUCTION

Cindy has worked at Betel for 18 years. She has served in a variety of roles from individual contributor to senior manager. She has worked in three geographies and is now based in U.S. Betel is a giant company in a high tech industry that needs rapid development in its projects. Cindy realizes that there has always been more work to do than time to do it. This is not a new problem. Every employee has the responsibility to prioritize their projects, and more importantly, levels set and get agreement on those priorities with their managers and stakeholders on a regular basis. The projects at the top of priority list are selected to carry out before projects at the bottom of the priority list.

Therefore, which tool that Betel can use to prioritize its project? How Betel can use that tool? Why is it important? These are questions that Cindy wants to test out in her company. She also wants to make sure that the projects at the top list are selected and resources are not waste with low priorities' projects.

BACKGROUND

Souder, Mandakovic, and Gupta (Gupta and Mandakovic, 1992; Souder and Mandakovic, 1986) introduce the approaches in project selection into two categories: environmental factors in an organization and analytical models. The first category, environmental factors in an organization, is composed of systems approach for the decision making process in an organization, behavioral aspects in motivations, aspirations, and attitudes toward risk of individual managers, and organizational goals and strategies that are combined with R&D project selection. The second category, analytical models, is mostly studied by operation research analysts. They are included checklists technique, economic indexes, and portfolio models. The portfolio models are divided into linear programming, non-linear programming, decision theory, network theory, dynamic programming, goal programming, integer programming, and simulation.

The environmental factors in an organization are discussed as follows:

- Systems approach: The studies of systems approach for the decision making process in an organization are based on the idea that a project comes from any department and at any level within an organization. This idea is viewed organization as a hierarchical unit. The study by Winkofsky, Baker, and Sweeney (Winkofsky et al., 1981) is shown a comprehensive approach to a decision process model of R&D resource allocation in hierarchical organizations. Kocaoglu (Kocaoglu, 1983) studies the individual and organizational aspects through a hierarchical decision process. His study also develops a hierarchical model with measurement of subjective values via constant-sum comparison. The model can apply to make decisions in many management situations such as post-program evaluation using an expert consensus, ongoing program evaluation, goal formation, capital expenditure, resource allocations, project selection, and project performance evaluation. Souder (Souder, 1978) studies how the selection of models in project evaluation affects organization setting in different situation. His study also describes the "Q-Sort (QS) /Nominal Interacting (NI)" process for project evaluation. The QS/NI process uses psychometric methods and controlled group interaction to meet organization and behavioral needs before any project evaluation model can be used effectively.
- Behavioral aspects: There are researchers conducting this study such as Rubenstein & Schroeder (Rubenstein and Schroder, 1977) and Schwartz & Vertinsky (Schwartz and Vertinsky, 1977). The study of behavioral aspects is focused on how the personal, organizational and other variables affect the probabilistic assessment of technical success for R&D projects. The relationship between the characteristics of executives such as position and function, the attributes of the organization, and the trade-offs in forming judgments is another behavioral aspect in R&D project selection.
- Organizational goals and strategies: The studies in this type of environmental factors are concerned the fact that R&D project selection may match and support the strategy of a business or a corporation. R&D program is considered to support the strength in the core technology of the enterprise and the funding for R&D may be produced the expected results in a case study of Allied corporation (Allio and Sheehan, 1984). Curd (Curd, 1982) also studies how R&D priorities can be matched with corporate strategy in a large textile producer. Another study by Hambrick (Hambrick et al., 1983) investigates determinants of R&D decisions in individual business units.

The analytical models are mainly classified into checklists, economic indexes, and portfolio models. Each of these models is described below.

- Checklists: Projects is checked with a given criteria to evaluate each project. The score on criteria of each project formulate the total score for each project respected to relative importance weight of each criterion. The example of a checklist model is studied by Becker (Becker, 1980). A checklist model or stating in another way as a quantitative scoring model is formulated as

$$T(j) = S(1, j) * W(1) + S(2, j) * W(2) + ... + S(M, j) * W(M)$$

where;

$T(j)$ is the total score for each project j
$S(i, j)$ is score of criterion I for project j
$W(i)$ is relative importance weight of criterion i

In the above model, assume that there are N projects to be evaluated with M criteria and each j^{th} is scored on every i^{th} criterion.

In addition to Becker's checklist model, there are other studies on this type of models such as Cooper (Cooper, 1978), Glazebrook (Glazebrook, 1976; Glazebrook, 1978), Krawiec (Krawiec, 1974), Merrifield (Merrifield, 1981), Paolini and Glazer (Paolini and Glaser, 1977), and Plebani and Jain (Plebani and Jain, 1981).

- Economic indexes: This approach is expressed in terms of economic factors such as the monetary value of a project, its probability of success, etc. to score and rank projects for index calculation. The instance of this approach is proposed by Ansoff (Ansoff, 1962). The economic index for scoring and ranking projects is as follows:

$$I(j) = \frac{(R \times D \times P \times (T + B) \times E)}{C}$$

Where:

I = Index
R = Probability of research success
D = Probability of development success
P = Probability of market success
T = Technical merit
B = Business merit
E = Present estimated value of earnings
C = Total required investment

Gupta and Mandakovic (Gupta and Mandakovic, 1992) considers the index model in the following prescription.

$$I(j) = P \times V$$

Where:

I = Index
P = Estimated probability of success of project j
V = Financial expression of value of project j, if successful

However, it can be formulated in different way to calculate the index for ranking projects. The formulation is

$$I(j) = P \times V + (1 - P) \times F$$

Where:

I = Index
P = Estimated probability of success of project j
V = Financial expression of value of project j, if it is success
F = Financial expression of value of project j, if it fail

The discussion of strength and weakness of two indexes above is also presented in the study by Gupta and Mandakovic (Gupta and Mandakovic, 1992).

- Portfolio models: This approach for selecting projects is based on the mathematical programming, which is to optimize objective function, subject to constraints and limited environments of the organization. Portfolio models can be divided into eight methodologies: linear programming, network theory, dynamic programming, integer programming, simulation, non-linear programming, decision theory, and goal programming. The general form of a portfolio model is:

$$\text{Maximize/Minimize} \quad \sum_j V(j)$$

Subject to:

$$\sum_j E(j) \le B$$

Where E(j) is a project expenditure, B is the budget for j = 1,2,…, N candidate projects for funding, and V(j) is the value of each project.

For other methodologies in portfolio models, they are particular cases of the general form of the equations above. Eight methodologies of the portfolio models are similar as the mathematical programming approaches in table 2-3. Thus, this section will be briefly presented the explanation of the models, which is not intended to duplication effort of study, but rather to present another way of explanation of those models.

1. linear programming (LP): LP can be re-written from the general form of a portfolio model as:

$$\text{Maximize/Minimize} \quad \sum_j V(j) * X(j)$$

Subject to:

$$\sum_j E(j) * X(j) \le B$$

$$X(j) \ge 0$$

Where X(j) is a decision variable for selecting project j. E(j) and V(j) are as defined in the above equations. The objective function is usually an expected value in financial or in cardinal measure terms. The constraint can be laboratory capacities, man-hours at a certain degree of skill, etc. The applications of LP are examined by Gear (Gear, 1974), Allen and Johnson (Allen and Johnson, 1971), and Bell and Read (Bell and Read, 1970).

2. Integer programming (IP): IP studied by Weintgarner (Weintgartner, 1966) can be re-written from the general form of a portfolio model as:

$$\text{Maximize/Minimize} \quad \sum_j V(j) * X(j)$$

Subject to:

$$\sum_j A(L, j) * X(j) \le B(L)$$

$$X(j) = 0 \text{ or } 1$$

Where:

$V(j)$ = Net present value of project j
$A(L, j)$ = Cost of project j in period L
B(L) = L^{th} period budget

$$X(j) = \begin{cases} 0, \text{ if project j is rejected} \\ 1, \text{ if project j is accepted} \end{cases}$$

This model determines the budget allocation to projects during a certain number of periods and select which projects should be supported.

3. Goal programming (GP): GP in R&D project selection is modeled to address the problem of multiple and conflicting goals. The GP studied by Baker (Baker, 1974), Keown et, al. (Keown et al., 1979) and Taylor et, al. (Taylor et al., 1982) is a model with multiple goals and use in a decision that has multiple criteria with no common, underlying measures. The application of goal programming to project selection is to satisfy goals in a sequential and/or simultaneous manner. GP is also formulated in non-linear zero one goal programming to cope with the decision that the relationship of resource allocated to a project and the outcomes of project success is not linear. The non-linear model selects projects and allocates researchers to projects with the purpose of satisfying a prioritized goal structure.
4. Non-Linear programming (NLP): NLP in R&D project selection is complex in mathematical expression. As a result, it lacks of users to apply NLP models in practices. The data that is required for the models is also not manageable because of its complexity of the model. The study of NLP in R&D process is conducted by Daubin (Daubin, 1958), Reisman (Reisman, 1965), Reiter (Reiter, 1963), and Sharpe (Sharpe, 1963).
5. Dynamic programming (DP): DP considers the sequential nature of the decision in R&D. The first study for R&D project selection using DP is conducted by Hess (Hess, 1962). The further DP models in R&D project selection are expanded from the Hess's model, for instance, the studies by Aldrich and Morton (Aldrich and Morton, 1975), Atkinson and Bobis (Atkinson and Bobis, 1969), and Rosen and Souder (Rosen and Souder, 1965). However, there are other studies that are not based directly by Hess's model and focused on application. For instance, the studies by Cord (Cord, 1964), Dean and Hauser (Dean and Hauser, 1967), are proposed their approaches of DP for selecting projects and Bobis et al. (Bobis et al., 1971) reports an actual application of a related model.
6. Network theory: The studies of network theory in R&D project selection are conducted by Marschak (Marschak, 1963) and Nelson (Nelson, 1961) through

PERT and by Baker, et al.[Baker, 1976 #102] through algorithms applied to R&D area.

7. Decision theory: This theory is developed to evaluate the overall utility of a given project, or set of projects. It is studied under risk analysis such as the work of Moore and Baker [Moore, 1969 #112] and under utility models such as the work of Souder . It is also evaluated projects by applying decision tree analysis such as the research accomplished by Flinn and Turban, and Hespos and Strassman.
8. Simulation: Simulation is a technique for selecting R&D project in a dynamic organization. However, its limitation is prohibited of its practice when an organization does not have a well established standard and flow of information. The study of simulation in R&D project selection can be found in Augood, and Gaver and Srinivasan.

ZERO BASED BUDGETS

Zero Based Budget (ZBB) is the principal tool for prioritizing projects at Betel. Cindy realized the other day that most people at Betel don't actually know what the term ZBB means any more. Everyone Cindy listen to seems to use the term ZBB as if it meant "I've just decided to stop doing this."

Or more likely, "I've got way too much on my plate, so I've ZBB'd this." Cindy decided to test out her theory. She asked a couple of colleagues what "ZBB" meant. The most common answer was "well you just stop doing something." (The "duh" was unstated.)

But the real head scratching came when Cindy asked the follow-on question "how do you ZBB something?" It has become clear that sometime in our recent history we have lost the recipe on how to ZBB. "ZBB" has morphed into a verb and a buzzword. And if no one knows how to ZBB, Betel have a big problem.

Zero Based Budget (ZBB) is a method of budgeting for projects in which all expenditures must be justified each new period, as opposed to only explaining the amounts requested in excess of the previous period's funding. ZBB uses as a planning tool to list out priorities, cost those projects, and identify which projects will receive funding and which will not. For example, if an organization used ZBB, each department would have to justify its funding every year. That is, funding would have a base at zero. A department would have to show why its funding efficiently helps the organization toward its goals.

ZBB reverses the working process of traditional budgeting. In traditional incremental budgeting, departmental managers need to justify only increases over the previous year budget. This means what has been already spent is automatically sanctioned. In case of ZBB, no reference is made to the previous level of expenditure. Every department function is reviewed comprehensively and all expenditures rather than only increases are approved. ZBB is a technique, by which the budget request has to be justified in complete detail by each division manager starting from the Zero-base. The Zero-base is indifferent to whether the total budget is increasing or decreasing.

The term "Zero-Based Budgeting" is sometimes used in personal finance to describe the practice of budgeting every dollar of income that you receive, and then adjusting some part of the budget downward for every other part that needs to be adjusted upward. It would be more technically correct to refer to this practice as "Active Balanced Budgeting," but personal finance tends to be judged by its effectiveness, rather than by the accuracy of the terminology.

In a broad sense, ZBB is composed of two elements: a process and a document. The process is a resource management tool used at all levels to allocate available resources to a prioritized list of projects. Helps managers define a realistic set of deliverables when the amount of work exceeds the resources available. The document is a list of projects and/or activities that are prioritized and allocated some level of resource (e.g. support now, postpone, delegate/reassign, or drop completely).

Why is ZBB important?

After Cindy reviewed ZBB (a tool in which Betel uses to prioritize its projects), she starts thinking about the reasons to convey her employee to belief the importance of ZBB. If Betel does not use ZBB, Betel will be inefficient in an overall use of time and resources. An alignment with project managers and their stakeholders is also missing. Without ZBB, it can cause poor performance and moral of the team. The advantage and disadvantage of ZBB can make Cindy's team to understand more on ZBB's technique. (See table 1 below)

TABLE 1 Advantage and Disadvantage of Zero Based Budget

Advantages of Zero-Base Budgeting	Disadvantages of Zero-Base Budgeting
1. Results in efficient allocation of resources as it is based on needs and benefits and forces cost centers to identify their mission and their relationship to overall goals.	1. Difficult to define decision units and decision packages, as it is very time-consuming and exhaustive.
2. Drives managers to find out cost effective ways to improve operations and Detects inflated budgets.	2. Forced to justify every detail related to expenditure. The R&D department is threatened whereas the production department benefits.
3. Useful for service departments where the output is difficult to identify and increases staff motivation by providing greater initiative and responsibility in decision-making.	3. Necessary to train managers. ZBB should be clearly understood by managers at various levels otherwise they cannot be successfully implemented. Difficult to administer and communicate the budgeting because more managers are involved in the process.
4. Increases communication and coordination within the organization.	4. In a large organization, the volume of forms may be so large that no one person could read it all. Compressing the information down to a usable size might remove critically important details.
5. Identifies and eliminates wastage and obsolete operations and identifies opportunities for outsourcing.	5. Honesty of the managers must be reliable and uniform. Any manager that is prone to exaggeration might skew the results.

Guidelines to review and rank projects with ZBB

Cindy realizes that Betel should have a guideline to use ZBB. She called for the meeting with her team (Laura, Michael, and Stacey) and brainstorming to find the nature of philosophy and practice for ZBB.

Cindy: "Today, I like to brainstorm for a guideline to use ZBB. I believe we are all known what ZBB is, why ZBB is important, and what advantage and disadvantage of ZBB are. Michael, what is your perspective on ZBB? Please, speak up."

Michael: "It is accounting oriented without any specific output input linkages, presented in the form of a departmental budget the funds being allocated to certain aggregated budget heads rather than to certain specific activities/ programs."

Cindy: "That is one thing for ZBB that we can think of. Well, other perspectives for ZBB?"

Stacey: "I think It is an 'aggregated expenditure budget', it does not provide to the top management any basis for restricting expenditure, in case of affordability, it prevents its total funding. Hence the arbitrary across the board cuts affecting high and low priority tasks equally."

Cindy: "That is a good one. Laura, what do you think about ZBB?"

Laura: "It is an extrapolation of the last year's budget by: a.) incrementing it for an assumed rate of inflation, b). providing for wages and salaries increases, c). adding new projects/programs or activities, d). realistic submissions-imprudent if not foolish -also get the inevitable cuts, and get less than necessary, e). across-the-board cuts are made again Clever not what they wanted, and f). cleverer learn their lesion and deliberately inflate their budget submission in future."

Cindy: "Wow, that is a wonderful answer. ZBB also accepts status quo as the fate-accomplish all the activities- old and new -that have been included in the next year's budget. The budget should be equally essential in achieving the objectives, and currently being performed in the most cost-effective manner."

After the brainstorm meeting, Cindy concludes the 6 steps process for setting ZBB.

Six Steps process for ZBB

The process for ZBB includes six steps. There are 1). understand organizational and department objectives, 2). develop key deliverables that support objectives, 3). prioritize key deliverables, 4). allocate resources and draw ZBB line, 5). agree & align with managers and stakeholders, and 6). execute to plan and make appropriate adjustments. The communication has to be conduct throughout the process.

Step 1: understand organizational and department objectives. It attempts to find the intersection of opportunity and capability. It is also to understand (1) where the business and

org are going, (2) what needs to be done, and (3) your capabilities to meet the needs and add value.

Step 2: develop key deliverables that support objectives. It collects input from management, team-members, and stakeholders. Without fresh input, the group relies on inertia & carry-overs from previous periods. Result is misalignment, low ROI activities, and wasted effort. The deliverables should write concisely and state business impacts. For example, the deliverables are "SMART" (Specific, Measurable, Achievable, Realistic, and Timely). It is also need to define success metric and key result."

Step 3: prioritize key deliverables. This step is to identify the highest priority items to maximize impact, given scope of job and available resource. Key elements of the prioritization process are 1). understand tradeoffs between "urgent" and "important," 2). use help-methods e.g. ABC prioritization, SSM (Start, Stop, Maintain), Pareto Principle (80:20 rule), 3). understand value to Betel for each deliverable, e.g. What will happen if the item gets pushed or dropped? Can the deliverable be scaled back to consume less resource? and 4). consult with management & stakeholders throughout.

Step 4: allocate resources and draw ZBB line. This step is to propose items below ZBB's line. (See table 2) It should escalate and get help if there are unacceptable business consequences of ZBB'ing.

Table 2 Propose items and draw ZBB line

Key Deliverable	Priority	Resource Required	Interdepen-dencies	Consequence of ZBB'ing	Commit Date	Status
XXX	A				Weekly	On track
YYY	A				Ongoing	On track
ZZZ	A				WW21	On track
ABC	B				WW25	On track
123	B		ZBB Line		EOQ	At risk
456	B				ZBB	Dropped
789	C				ZBB	Pushed

Step 5: agree & align with managers and stakeholders. The ZBB process does not work without this step. It needs to communicate often with your stakeholders (manager, business partners, internal customers, peer functions, your team, etc…). The communication process should include: a). what is "above the line" AND what you propose to ZBB, b). opportunities for stakeholders to influence your ZBB, c).negotiation on priorities and due dates, and d). escalation of any items "at risk" due to lack of resources. It should ensure that you get co-ownership with your management (you succeed or fail together).

Step 6: execute to plan and make appropriate adjustments. This step focuses on execution e.g. 1). plan out your quarter, week, and day, 2). leave some buffer time for unexpected requests, 3).practice good time management – discipline yourself to work on the most important items first (vs. the easiest, etc…). It is flexible and makes appropriate adjustments. For example, it recognizes that we work in a dynamic business environment. New items will appear and organizational priorities will change. Your ZBB process needs to be dynamic. It regularly renegotiates your ZBB list and due dates with management & stakeholders. It is also needed to regularly reprioritize: assess new requests versus current list.

CONCLUSION

In school, and in some other places Cindy have worked, assignments were given out in a more "measured" way. The expectation was that everything you were given would get done. Or else. At Betel, not so. Your manager or your customers will keep piling things onto your plate until you never leave work.

Remember: ZBB is about maximizing your contribution and delivering results using all available resources. Practicing good prioritization & ZBB is key for the success of Betel and your success at Betel. You should practice the 6 step process: 1). understand the big picture, 2). write SMART deliverables that have clear value-add, 3).use a proactive & methodical approach to prioritizing, 4). allocate resources with focus on impact and quality, 5). agree and align with managers and stakeholders, and 6). execute and adjust along the way. You should also communicate early and often.

There are lots of other things that are critical to success at Betel: talent, brains, hard work (and luck). But in Cindy's experience, figuring out ZBB is number one. Take control of your own ZBB – if you don't, nobody else will!

QUESTIONS

1. What is ZBB? Why is ZBB important?
2. Construct a 1 sentence goal for you or your team representing what you would like to take away from this case. e.g. "**My (our) ZBB goal is to…**"
3. What are 3 actions that you are going to take in the next 2 weeks based on steps 1-3 of ZBB process?
4. What are some of the key elements of the prioritization process using ZBB?
5. What are the consequences of NOT setting good priorities up front?
6. What are advantages and disadvantages of ZBB?
7. How ZBB is used? Explain its process.
8. What are 3 actions that you are going to take in the next 2 weeks based on steps 4-6 of ZBB process?
9. What will you discuss with your manager in the next 2 weeks on your key learning from this case?
10. What do you plan to do differently as a result?

ACKNOWLEDGEMENT

The authors would like to thank Faculty of Business Administration at Kasetsart University for financial support in this research. We also would like to acknowledge our thanks to the anonymous reviewers for their valuable comments.

REFERENCES

1. Aldrich, D. and Morton, T.E. (1975), "Optimal funding paths for a class of risky R&D projects", *Management Science,* vol. 21, no. 5, pp. 491-500.
2. Allen, D.H. and Johnson, T.F.N. (1971), "Realism in LP modeling for project selection", *R&D Management,* vol. 1, no. 2, pp. 10-15.
3. Allio, R.J. and Sheehan, D. (1984), "Allocating R&D resources effectively", *Research Management,* vol. July-August, pp. 14-20.
4. Ansoff, H.I. (1962), 'Evaluation of applied research in a business firm', in JR Bright (ed), *Technological planning on the corporate level*, Harvard university press, Massachusett.
5. Atkinson, A.C. and Bobis, A.H. (1969), "A mathematical basis for the selection of research projects", *IEEE Transactions on Engineering Management,* vol. 16, no. 1, pp. 2-8.
6. Baker, N.R. (1974), "R&D project selection models: an assessment", *IEEE Transactions on Engineering Management,* vol. 21, no. 4, pp. 165-171.
7. Becker, R.H. (1980), "Project selection checklist for research, product development", *Research Management,* vol. 23, pp. 24-29.
8. Bell, D.C. and Read, A.W. (1970), "The application of a research project selection method", *R&D Management,* vol. 1, no. 1, pp. 35-42.
9. Bobis, A.H., Cooke, T.F. and Paden, J.H. (1971), "A funds allocation method to improve the odds for research successes", *Research Management,* vol. 14, no. 2, pp. 34-45.
10. Cooper, M.J. (1978), "An evaluation system for project selection", *Research Management,* vol. 21, pp. 29-33.
11. Cord, J. (1964), "A method for allocating funds to investment projects when returns are subject to uncertainty", *Management Science,* vol. 19, no. 5, pp. 335-341.
12. Curd (1982), "Avoiding pie in the sky", *Research Management,* vol. 25, pp. 34-41.
13. Daubin, S.C. (1958), "The allocation of development funds: An analysis approach", *Naval research logistics quarterly,* vol. 3, pp. 263-276.
14. Dean, B.V. and Hauser, L.E. (1967), "Advanced material systems planning", *IEEE Transactions on Engineering Management,* vol. 14, no. 1, pp. 21-43.
15. Gear, A.E. (1974), "A review of some recent developments in portfolio modeling in applied research and development", *IEEE Transactions on Engineering Management,* vol. 21, no. 4, pp. 119-125.
16. Glazebrook, K.D. (1976), "A profitability index for alternative research projects", *Omega,* vol. 4, no. 1, pp. 79-83.
17. Glazebrook, K.D. (1978), "Some ranking formulae for alternative research projects", *Omega,* vol. 6, pp. 193-194.
18. Gupta, S.K. and Mandakovic, T. (1992), 'Contemporary approaches to R&D project selection: a literature search', in DF Kocaoglu (ed), *Management of R&D and Engineering*, North Holland, Amsterdam, pp. 67-87.

19. Hambrick, D.C., MacMillan, I.E. and Barboza, R.R. (1983), "Business unit strategy and change in the product R&D budget", *Management Science,* vol. 29, no. 7, pp. 757-769.
20. Hess, S.W. (1962), "A dynamic programming approach to R&D budgeting and project selection", *IEEE Transactions on Engineering Management,* vol. EM-9, no. 4, pp. 170-179.
21. Keown, C.E., Taylor, B.W. and Duncan, C.P. (1979), "Allocation of research and development funds: a zero-one goal programming approach", *Omega,* vol. 7, no. 4, pp. 345-351.
22. Kocaoglu, D.F. (1983), "A participative approach to program evaluation", *IEEE Transactions on Engineering Management,* vol. 30, no. 3, pp. 112-118.
23. Krawiec, F. (1974), "Evaluating and selecting research projects by scoring", *Research Management,* vol. 18, no. 2, pp. 21-25.
24. Marschak, T.A. (1963), 'Models, rules of thumb, and development decision', in BV Dean (ed), *Operations research in research and development*, John Wily and Sons, New York.
25. Merrifield, B.D. (1981), "Selecting project for commercial success", *Research Management,* vol. 24, pp. 13-18.
26. Nelson, R.R. (1961), "Uncertainty, learning, and the economics of parallel research and development efforts", *The Review of Economic and Statistics,* vol. 43, p. 351.
27. Paolini, A. and Glaser, M.A. (1977), "Project selection methods that pick winners", *Research Management,* vol. 20, no. 3, pp. 26-29.
28. Plebani, L.P. and Jain, H.K. (1981), "Evaluating research proposals with group techniques", *Research Management,* vol. 24, pp. 26-29.
29. Reisman, A. (1965), "Capital budgeting for interrelated projects", *Journal of Industrial Engineering,* vol. 16, no. 1, pp. 59-64.
30. Reiter, S. (1963), "Choosing an investment program among interdependent projects", *Review of economic studies,* vol. 30, no. 82, pp. 32-36.
31. Rosen, E.M. and Souder, W.E. (1965), "A method for allocation R&D expenditures", *IEEE Transactions on Engineering Management,* vol. EM-12, no. 3, pp. 87-93.
32. Rubenstein, A.H. and Schroder, H.-H. (1977), "Management differences in assesing probabilities of technical success for R&D projects", *Management Science,* vol. 24, no. 2, pp. 137-148.
33. Schwartz, S.L. and Vertinsky, I. (1977), "Multi-attribute investment decisions: A study of R&D project selection", *Management Science,* vol. 24, no. 3, pp. 285-301.
34. Sharpe, W.F. (1963), "A simplified model for portfolio analysis", *Management Science,* vol. 9, no. 2, pp. 277-293.
35. Souder, W.E. (1978), "A system for using R&D project evaluation methods", *Research Management,* vol. 21, no. 5, pp. 29-37.
36. Souder, W.E. and Mandakovic, T. (1986), "R&D project selection models", *Research Management,* vol. 29, no. 4, pp. 36-42.
37. Taylor, B.I., Moore, L.J. and Clayton, E. (1982), "R&D project selection and manpower allocation with integer nonlinear goal programming", *Management Science,* vol. 28, no. 10, pp. 1149-1158.
38. Weintgartner, H.H. (1966), "Capital budgeting for interrelated projects: survey and synthesis", *Management Science,* vol. 12, no. 7, pp. 485-516.
39. Winkofsky, E.P., Baker, N.R. and Sweeney, D.J. (1981), "A decision process model of R&D resource allocation in hierarchical organizations", *Management Science,* vol. 27, no. 3, pp. 268-283.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

COMPARING MANUFACTURING AND SERVICES SOURCING AGAINST R&D SOURCING

Marzieh ShahmariChatghieh*, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610,FI-90014, Finland
E-mail: negarshahmari@gmail.com

Harri Haapasalo, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610,FI-90014, Finland
E-mail: harri.haapasalo@oulu.fi

Anyanitha Distanont, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610,FI-90014, Finland
E-mail: Anyanitha.Distanont@oulu.fi

ABSTRACT

Purpose *– The aim of this paper is to compare the critical issues (quality, cost, flexibility, competitiveness, resource utilization and innovation) of sourcing in manufacturing, service and R&D companies in order to explore the most crucial characteristics of R&D supply chain to define the most efficient strategy to source R&D.*
Design/methodology/approach *– The research was conducted with a qualitative approach through a literature analysis.*
Findings *– The final result is a comparison of the factors in manufacturing, service and R&D sourcing, to find out the framework to further analyze sourcing in R&D.*
Originality/value *– This research contributes to modifying the methods and strategies of sourcing in R&D sector, which have been used in manufacturing and services logistics.*

Keywords: Sourcing, R&D, supply chain
Paper type: Research paper

INTRODUCTION

Nowadays in competitive atmosphere of industries, all the companies try to produce the best product to gain customer satisfaction and market share. Companies which could survive in the *fiercely competitive marketplace must* work in accurate way, at accurate time and accurate place at all parts of their value chain. The efficiency and supreme productivity should come from all individual parts of the supply chain in order to match and control whole supply chain. Moreover, organizations have to use the most appropriate directions and procedures which come from proper strategies.

Moreover numerous researchers have investigated about different features of different supply chains. Some studies considered the manufacturing supply network characteristics (Feurer and

Chaharbaghi, 1994; Beaman, 1999; Harrison and Van Hoek, 2011), some of them focused on the service sector supply chain structures and influential factors (Fitzgerarld et al., 1991; Ellaram et al., 2004; Lehtonen and Salonen, 2006; Safizadeh, 2008). Additionally in last decades researchers are becoming more interested in R&D sector due to its essential role in competitiveness of organizations. There are various studies tried to point out its significant factors (Menke, 1991; Cooper and Kleinschmidt, 1994; Hagdoorn, 2002). Moreover there are some studies tried to modify manufacturing and service supply chain management models into the R&D supply network circumstance (e.g., Prajogo and Sohal, 2001).

According to the previous studies, it can be seen that there are many methods and procedures have been modified from manufacturing supply chain management to services sourcing network and most studies focused on manufacturing supply chain and services sourcing rather than on R&D sourcing. Moreover there is no research which tries to investigate the differences and similarities of R&D, manufacturing and services sourcing. Therefore this research tries to address this gap by investigating the significant factors of manufacturing and service supply networks in order to compare with R&D supply chain.

The purpose of the paper is to compare the critical issues of sourcing in manufacturing, service with R&D companies. In order to meet the objective of this study, the following research questions need to be answered:
RQ: What are the main differences and similarities of souring for tangible manufacturing and intangible services compared to R&D sourcing?

THE LOGIC OF THE PAPER

As mentioned in the introduction part, the purpose of the paper is to compare R&D sourcing with manufacturing and services supply chains. The manufacturing and services supply chains are more studied in the literature, thus their main characteristics are studied and compared to match with the same factors in R&D sourcing. To ease the comparing process and have a comprehensive insight, the supply chains are seen as systems with input, output and processor. Due to the effective role of inputs and products of each supply chains to make them different with each other, inputs and outputs of each of the systems_ manufacturing, services and R&D supply chains, are defined and compered in the 3rd chapter.

As the wideness of processor factors, some more bold issues should be compared in the processor part. Thus the performance dimensions of Fitzgerarld et al (1991): quality, cost, flexibility, competitiveness and resource utilization are seen as the most crucial issues in the area and compared in the 4th chapter. There are various other critical factors in supply chain, which could not be described in the paper. So the study as a scope belongs to only some factors that are considered as significant issues in sourcing. The logic of the comparison between the mentioned criteria was finding out the boldest similarities and differences from literatures in general view points. It is tried to find out the most common factors which could be belonged to all the industries but if there is any special example from special industries they are mentioned in the text. More over all the factors are seen from buyers view point.

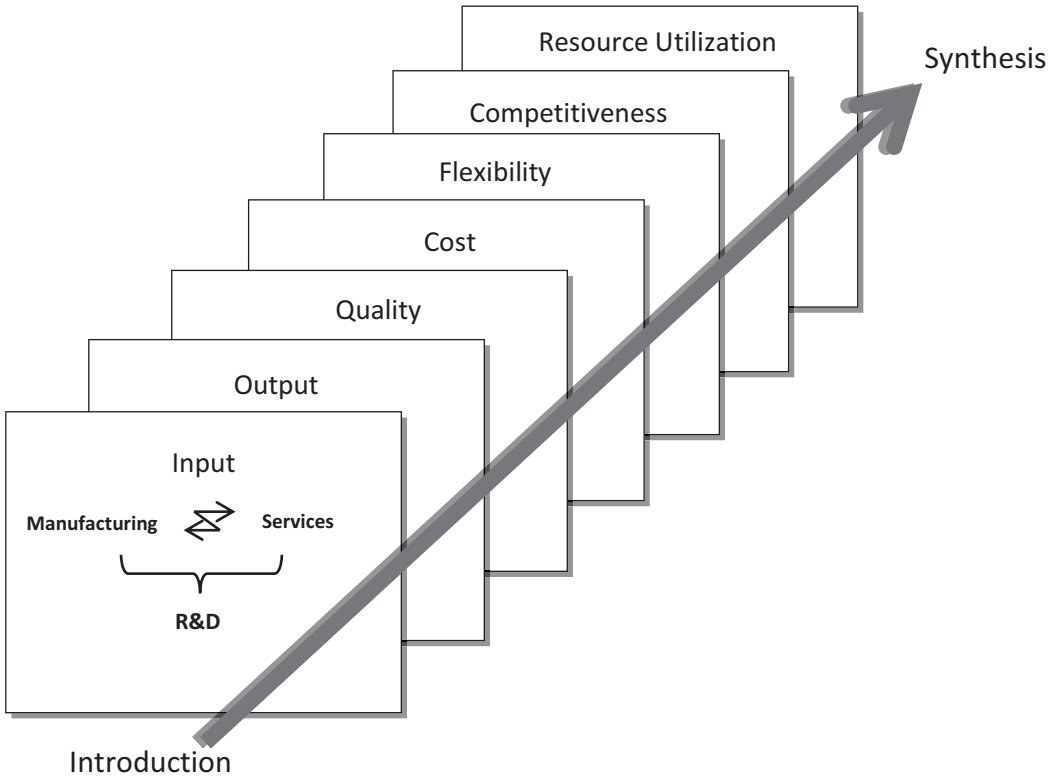


Fig. 1. Logic of the paper

1 Inputs and Outputs

Inputs are material, information, permissions and all properties which used in a process to gain required output which called product. The purpose of supply chain network players in any sector is to deliver products to customer. The characteristics of product determine the characteristics of supply chain and all of its drivers and activities

1.1 Manufacturing Supply chain

As Heshmati (2003) mentions inputs in manufacturing sector are material, capital, labor and energy to pass proper processes through add-value network, to be converted into outputs, which could be known either as physical objects or monetary values. Additionally, various authors try to classify the outputs of manufacturing by different features; as an example, Huang et al. (2002) classify the products in manufacturing sector to obtain appropriate supply chain management strategy; they introduce three groups of products: Functional, Innovative and Hybrid products. It is necessary to mention that the classification of products could be done by different industries and various purposes.

1.2 Services Supply Chain

Categorizing inputs in service companies is more or less the same as manufacturing companies, as Siegel and Grilichez (1992) represent, inputs of services companies are capital, labor, material, energy, exactly like manufacturing, moreover they add purchase of services besides the inputs of manufacturing sector. Heshmati (2003) points out that the costs which the company efforts for development could be known as an input. Classifying and evaluating inputs is totally easier than calculating and categorizing outputs, cause outputs of services sector include wide range of activities and products.

Lööf and Heshmati (2002) emphasize on the role of employees and assume that the output of service sector could be measured by value added per personnel, but the researches which study more detailed in various industries, illustrate more specific definitions, for example output of an educational institute is seen as registered student and for medical care centers the number of outpatients which checked in and inpatients which checked out are identified as outputs of the system (Rosko, 2001).

1.3 R&D Supply Chain

In current situation that the product life cycle is continuously becoming shorter, proper R&D and fast development could be the success factor of a company. Therefore, R&D process needs some supplementary inputs in compare with the service and manufacturing sectors, in R&D sector, in addition to labor and material the company needs specific data, information and knowledge. Labor is known as the people who participate in the process of research and development which could be referred to technicians and employees who are participating in prototype creation as well, material is the most obvious input of the processes which is needed for simulation, tests and prototype creation phase, but the knowledge, data and information is the base part of R&D inputs.

2 Performance dimensions of Supply chain comparison

2.1 Quality

Obviously the first priority of every company should be quality. There have been lots of companies which preferred cost reduction than quality, although studies depicted the outcome have been revenue reduction, one of the famous examples of this strategy is Toyota behavior which Cole (2011) investigated its reasons and characteristics. The quality is not only the right characteristics of product but the right activity of whole supply network. Therefore some researchers produce concept of SCQM (Supply Chain Quality Management) to transfer the process of quality evolution through all parts of supply chain (Carmignani, 2009). Moreover, Malhotra and Robinson (2005) suggest that quality approaches like ISO 9001 (2000) should assure quality from inside supply chain instead of separated methods to control supply chain and quality.

2.1.1 Quality in Manufacturing Supply Chain

To modify the old quality management system into SCQM, the companies should build a quality assurance system for the supply chain as a unify network, for instance Kuei et al. (2008) describe four steps for implementing SCQM in companies, Furthermore, Fish (2011) recommends some supportive activities to shift from traditional quality management in the supply chain into SCQM, which could promote the effectiveness of the efforts and ease the implementation of the approach.

2.1.2 Quality in Service sector supply chain

Bolton and Drew (1991) define service quality as the ratio of customer perception and company performance which is different from customer satisfaction. Lots of studies have done to find out the factors of service quality with various methods, Grönroos (1988) represents the customer observation of companies' activities into two groups: functional and technical. Parasuraman et al. (1985) study 22 factors which considered as effective elements of the quality of service and represent empathy, assurance, responsiveness, tangibles and reliability as the elements of customer perceptions of service quality and introduce SERVQUAL model.

Haywood-Farmer (1988) classifies possible factors which could be effective in the customers feedback from the services into: physical, behaviors of personnel and professional judgments; additionally furthermore, some other researchers like Santos (2003) and Dabholkar (1996) specify in particular industries for defining service quality factors and define models for e-commerce and self-service technologies.

Most of the researches have done only to measure and evolve technology in companies scale; although from supply chain management view point when the whole parts of chain are included in the quality assessment the process is more effective (Nix, 2001; Seth et al., 2005). Therefore researchers in the supply chain management field try to define service quality from network scale insight. In accordance with the definition of service quality the service quality in supply chain is defined as ratio of expectation to performance of each network player and whole add-value network (Seth et al, 2006).

Even though most of the studies in the area do not include requirements to harmonizing whole supply chain, the studies are illustrated that service quality programs lead to better performance of whole supply chain (Mentzer et al., 2000; Stanly & Wisner, 2002). Therefore Seth et al. (2006) try to modify service quality models to unify the whole network players in quality assurance programs by extending SERVQUAL model of Parasuraman et al. (1985), which is used by other researchers in empirical studies in various service companies like educational institute (Jacksen et al., 2011), health care centers (Fantazy et al., 2010) and management consultant (Giannakis, 2011).

Dale et al. (1997) demonstrate the differences between quality management in service provider organizations and manufacturing companies. They find out that quality in services sector is very

human factor centric, the behavior of personnel _ away from the technical performance of the service, could promote customer satisfaction or demote it.

2.1.3 Quality in R&D Supply chain

Menke (1991) mentions success factor of R&D as: working on the right project by proper people and appropriate process, so the framework which could illustrate "right" project, "proper" people and "appropriate" process is constructing quality. Subsequently he classifies the quality assessment stages. the first level is evaluation feasibility of the project according to market area, strategy of the company and lots of other statistical and qualitative data; which could be gained from strategy table, influence diagram, new product revenue forecast, sensitivity analysis and decision trees as suitable approaches for evaluation and prioritization of various R&D projects.

For the second and third stages of quality assurance, due to the similarity of these processes into manufacturing and services sectors, the approaches which have been implemented successfully in those sectors are mostly modified by various authors. For instance (Prajogo and Sohal, 2001) modify TQM for R&D sector, which is one of the most popular quality approaches in manufacturing and had been modified for service provider organizations too. In addition, Benner and Tushman (2003) argue that with mixture of process management and customer focus approach, company could make a quality structure that the process management approaches guarantee the quality part of processes and customer focus approaches carry the effectiveness of voice of customer in development and innovation process.

2.2 Cost

Simchi-Levi et al. (2007) classify cost as one of the features which customer evaluates each company's products with. Therefore, lower price is one of comprehensive competitive strategies and cost reduction is a factor which even in luxurious products is considered besides keeping high quality of products, to increase profitability of the company.

2.2.1 Cost in manufacturing supply chain

Beaman (1998) who studied about the performance of supply chain considers 4 approaches to promote profitability of a supply chain: minimizing costs, minimizing average inventory level, minimizing obsolete inventory and maximizing profit. Furthermore, other researches go beyond the details and suggest some methods to reduce costs, Camm et al. (1997) believe that the distribution centers allocation optimization and lower costs of transportation lead to less total costs. Moreover they give a stochastic based method to make efficient the numbers and locations of distribution centers; likewise, Lee and Feitzinger (1995) besides evaluating the number of distribution centers, calculate wide range of activities costs in supply chain from set up costs to inventory costs, to form whole integrated channel, cost efficiently.

From various viewpoints in supply chain studies, inventory level and allocation are crucial factors; Pyke and Cohen (1994) investigated about the inventory cost efficiency, they compute replenishments size and time, orders characteristics and amount of products in each batch to

prevent delays. Besides Lee et al. (1993) try to reduce inventory levels by production allocation. Furthermore, Altiok and Ranjan (1995) model attempts to lessen the inventory level by forecasting time and number of orders accurately. Towill and Del Vecchio (1994) by modifying filter model endeavor to minimize the number of inventories and their costs. Moreover, Ishii et al. (1988) suggest a method to reduce the inventories by identifying and eliminating obsolete products from them.

Several researches define models to cover all supply chain players in a unified cost efficient program. As Cohen and Lee (1988) create a model to increase supply chain profitability. According to their model all parts of supply chain are under control restrictedly. Besides, Jonrinaldi and Zhang (2013) optimize costs of whole supply chain with less restriction according to the demand forecast and products life cycle. Also Tzafestas and Kapsiotis (1994) introduce a procedure to improve entire network activities, thus they recommend three various approaches to evaluate supply chain players.

2.2.2 Cost in Service Sector Supply Chain

As described before, one of the customer preferences is lower cost in gaining appropriate services; simultaneously the company's target is to achieve both customer satisfaction and more profit. As Johnston and Glark (2008) represent high quality service delivery leads to absorbing more customers which brings better financial performance for the company. Therefore managers try to make supply chain efficient to provide high quality services with lower cost.
Frei (2006) recognizes various strategies to reduce cost beside keeping customer satisfied, he suggests some tips to make efficient supply chain as labor allocating view point, for instance: using cheap labor and outsourcing some activities to other countries with lower cost labors, try to automate the process as much as possible to eliminate human factors failure and make maintenance line cheaper, outsource customer contacts, ease tough processes in a way that they need less skilled employees. Although the entire decision making should be done carefully with all aspects and costs consideration, for example outsourcing labor could have some hidden cost for the company which should be taken into account (Ellaram et al., 2004).

2.2.3 Cost in R&D Supply Chain

In the beginning of every R&D project, one the most crucial concerns of stakeholders is the financial performance of the project result and suitability of the developed or innovative product with the situation of market, at the release time. Therefore a significant part of R&D project is financial estimation. Apparently known estimation methods for expected sale, revenue and other financial values are inadequate for a complete consideration of a R&D project. It is necessary to notify qualitative variables as well, these variables are illustrated situation of company, market and environment impressions against the new product release.

Additionally always there have been trade-offs between low cost innovation with high revenue, and costly researches to find out new infrastructures and build innovative products. Moreover time is another factor which makes R&D projects costly; as Dunk and Kilgore (2001) represent high competition on cost in short term projects, rather than innovation. Furthermore, Thoma and

O'Sullivan (2011) compare costly innovations in car industries of Germany and low cost built production lines in china.

Totally costs of R&D projects which gain from quantitative procedures like NPV (Net Present Value) and qualitative models like game theory lighten up the potential and future of each idea and project that the company should decide whether the potential goals, revenues, built infrastructures are in line with the company's strategies and invest on them.

2.3 Flexibility

Flexibility is capability of system to adjust with the changes which is made by the customer requirements, suppliers' feedings and any other environmental or internal factors, quickly and efficiently (Beaman, 1999). In accordance with the available uncertainty in all industries one of the success factors of any supply chain is high flexibility. Thus if the company wants to stay in competitive market should increase the flexibility as much as the level of uncertainty. Demand fluctuation, technology uncertainty, environmental problems like economic problems, contractual collapse in external sourcing and even natural contingencies like earthquake and tsunami can lead to high uncertainty in various occasions for manufacturers and manufacturer cannot remain in the market place without high level of flexibility.

2.3.1 Flexibility in manufacturing supply chain

Researches try to find out different kinds of flexibilities to gain the elements of them and solve the problem by finding its compositions. Hence, Slack (1991) identifies two different flexibilities in the manufacturing sector; Range flexibility which is the tolerance area that the operation can be adapted with changes, and respond flexibility, the value of changing operational direction (time, cost or both), it is necessary to mention that the extension of operational changes (range flexibility) is limited but it should be adjusted with level of uncertainty, which exist in the market circumstance.

In addition D'Souza and Williams (2000) represent volume, variety, process and material flexibilities as compounds of manufacturing supply chain flexibilities, that each of them has two subgroups of range and mobility. There are various categorizing of flexibilities from different viewpoints, for example Slack (1991) determines four distinct types of flexibilities in manufacturing network; volume, delivery, mix and new products flexibilities, which are represented to ease the classification of duties for finding out the gaps and increase flexibilities. Another interesting classification of flexibilities belongs to Koste and Malhorate (1999) that have a hierarchical approach and study all part of the supply chain which begins with the strategic flexibility and continues to individual personnel and contractors.

Subsequently, lots of investigations have done to determine the effective factors on flexibility and its measurement; Christopher (1992) describes flexibility measuring dimensions, as regular set up and product development time, economy of scope and the number of inventories. Moreover, Slack(1983) mentions that flexibility measurement is complicated due to various dimensions and facts _actually and potentially, that flexibility could be influenced by. Sethi &

Sethi (1990) realize 15 various dimensions of flexibility in manufacturing sector which encompass marketing, human factor and manufacturing criteria.

2.3.2 Flexibility in service sector supply chain

Any fluctuation in entering input or demanding output and technology of system cause uncertainty which leads to lower level of performance in absence of flexibility. Logically when high uncertainty situation occurs (e.g. variation in demand) the company would look for increasing numbers or variation of resources which not only is costly but also if the fluctuation would be temporary the company encounter useless provided inputs, therefore the company have to find out models to control such kinds of changeable conditions that is the concept of flexibility (Iravani et al. 2005).

But flexibility in services is even more complicated, the employees always are in close interaction with customers and one of the customer satisfaction factors is the officers behaviors which is almost unique for every customer, therefore in services companies customization is very common which is one of uncertainty factors (Aranda, 2003), thus flexibility known as high potential of company in customization (Iravani et al. 2005).

Different researches tried to find out different models for improving flexibility of companies in service sector, some researches emphasize on the resource or labor allocation and for each task or demand introduce two or more employee to reinforce the demand variations (Iravani et al, 2005) or some others study on the companies which provide product and services in the same time or provide service by using technological devices, prefer to use higher technological devices to evolve flexibility. Although Gupta and Somers (1996) believe that technology development does not cause better market share and competitive paramount. Therefore for gaining better flexibility in service supply chain, whole the adding value network should be flexible; as Chambers (1992) represents, the flexibility of supply chain is not possible without flexibility of all parts of the network.

Furthermore all parts of network should be prepared to adapt with environmental variations to guarantee the whole chains flexibility. Suarez et al. (1996) describe that from the design and introduction phase to the end of product life cycle, all the activities and duties should be flexible. Furthermore, resource management in addition to demand quality and quantity evaluation, should be adapted with all the variability and uncertainties which could happen, to prevent unutilized components and human factors or lack of resources.

2.3.3 Flexibility in R&D supply chain

Existence of uncertainty in all R&D projects is obvious, and negative effect of high uncertainty situation on the revenue of R&D projects is apparent as well. Therefore the whole chain structure should be flexible enough to triumph against at least some amounts of uncertainties. Furthermore it is necessary to mention that, due to some characteristics of R&D sector like output which is

almost vague in some R&D projects, lead time that could be floating and market situation in product introduction time which could be unknown, flexibility management in R&D is more complicated in compare with manufacturing and service sectors. Moreover, due to all unstable situations which named above the tolerance of flexibility in R&D should be wider.

Flexibility in R&D sector contains wide concept during various stages of development projects, which the project managers should decide whether to change the directions and plans. As mentioned, first phase of a R&D project is the evaluation or planning phase, that the company decides which idea could be more productive and efficient in accordance with the current information from customer demand, competitors' situation and market but in case of unstable condition, big fluctuations could destroy all plans of project. Moreover the whole chain structure should be prepared and flexible enough to react against the changes those are harmful or even useful for projects (Santiago & Vakili, 2005).

For the first phase of evaluation and concept studies, there are lots of models to evaluate various aspects of R&D potential projects like NPV (Net Present Value) or others which mentioned in the quality part, but most of them study current situation of company and disregard the uncertainty of the environment (Huchzemier & Loch, 2001). Schwartz and Trigeorgis (1997) adapted Real option theory which mostly used in corporate finance, to make the R&D projects more flexible by evaluating the process and effective environmental factors in each stage of the project. He gave 5 options in each stage to harness uncertainty like defer and abandonment.
Then Huchzemier & Loch (2001) expand his theory which contains more uncertainty factors in R&D like budget fluctuation, lead time delay, product characteristics and performance in addition to market factors, to make it more applicable in R&D flexibility measurement. Furthermore sequential model of Roberts & Weitzman (1981) is another effort to identify a method to restrain uncertainty in research and development projects.

2.4 Competitiveness

Recently, in the speedy developing technology area which leads to increasing customer requirements and shortening product life cycle, one of the most crucial considerations of managers and firms stakeholders is remained in the market and competition of industries by promoting competitiveness of their products and processes. Some authors like Cleveland et al. (1989), Kim and Arnold (1993) and Vickery et al. (1991), recognize strategy as the factor to remain in the competition between companies in industry and only mention competitiveness as a way to find out the level of production harmonization with strategic goals.
Feurer and Chaharbaghi (1994) define competitiveness as not only potential of knowledgeable employees and technological equipment to keep production activities synchronized with the strategic targets, but also capability of the company to manufacture and modify the manufacturing system with changing competitive environment. Away from various definitions details, all of them imply that competitiveness is a characteristic to stay in the market by having qualified products and capabilities, from customer viewpoints and following the strategic directions.

2.4.1 Competitiveness in manufacturing supply chain:

As the definitions are different, various studies distinguish various factors and criteria for this concept although they are similar and some of them are just repeated. Arze and Svensson (1997) emphasize on the level of equipment technological potentials and employee's knowledge on the degree of competitiveness; El Mhamedi and Binder (1992) argue about human factors effectiveness too. In addition, Gardiner and Gardiner (1997) constitute systematic management as another driver of the concept.

Consequently, researchers attempt to create methods and calculate the competitiveness of a manufacturing organization, for instance Feurer and Chaharbaghi (1994) consider people, technology, shareholders value, financial strength and customer value as the factors which the competitiveness could be evaluated by measuring their performance and mention that a sustainable competitiveness would be happened in the balance of all the factors.

Moreover, Chiang Kao and Shiang-Tai Liu (1999) assume that two dimensions of technology and management, that each of them contains various sub factors, are the base drivers of competitiveness. In accordance with the fact that some factors are not qualitative to be mentioned in mathematical statistics, they try to model competitiveness and all the drivers by fuzzy. They identify equipment quality and quantity, employees' knowledge and its appropriation to the level of automation, control level and technological capabilities as the sub factors of technology and try to convert the qualitative variations into fuzzy specifications. Furthermore they used from Amrine et al. (1993) description of effective components management.

2.4.2 Competitiveness in service sector supply chain

Porter (2000) besides defining service competition as a dynamic concept, which try to promote service strategies by innovation and development, argues that location is an effective factor in the service competitiveness that leads to increase productivity. So (2000) describes time and price as the most effective factors in competitiveness of service companies, moreover he emphasizes that time accuracy leads to more customer satisfaction. Moreover, Allon and Federguen (2007) classify competitiveness factors of service sector: price, time and other attributes. The last dimension which they describe is "other attributes" which refer to technical quality of company's core business that is the reason which customer is looking for the services.
Due to variation of "other attributes" factors in various industries, the researchers define "full price" concept, to find out unified structures for all the services companies competitiveness, which argue about competitiveness by functionalizing price and time with the assumption of the same rate of other attributes in all the services companies. Thus time and cost are implicit functions of each other from customer viewpoint. Additionally Carmonel et al. (1994) depict "full price" function is nonlinear. Moreover, Allon and Federguen (2007) according to constant level of "other attribute" in all the service provider companies, distinguish three various strategies for increasing competitiveness, first is improving capability to reduce both time and cost, second is trying to decrease customer waiting time and the third is price reduction strategy.

Apparently, core business of service provider organizations is the key point of competition. As mentioned, for evolving quality of service and product of the company the enterprise needs to have high technology development and innovation in the services and products but due to variation in the services core businesses and close relation between customer and employees situation and psychological factors, competitiveness in services is more complex in compare with manufacturing sector's competitiveness. Still, as described above price and quality are crucial competitive factors.

2.4.3 Competitiveness in R&D supply chain

Apparently, R&D known as the most fundamental company's solution to remain in the market competition and promoting its competitiveness features. In addition, the company identifies its competitive strategies to shape R&D and follow the plans, therefore all details of R&D projects are influenced by the company's competitive strategy from innovative topic selection and the projects budget to scheduling, in accordance with the companies capabilities (Cooper & Kleinschmidt, 1994). The competitive strategies could be seen from various aspects, moreover companies define different kinds of competitive strategies in various industries and environment, thus researchers have classified the competitive strategies from diverse insights, that each of them leads to gain special goals. Strategy could be identified as one of the success factors of R&D projects. Two various categorization of competitive strategy for R&D are describe below that first one is comprehensive for all industries and the second one is given especially for high tech industries.

Ulrich and Eppinger (2008) suggest a classification for competitive strategy which is applicable in various ranges of industries. They describe that companies could emphasize on technological development to introduce pure new technological products based on new technologies in industry, the most visible example in this area is the introduction of ipad by Apple company which is applicable by various customer segments (Wang et al., 2012).
Moreover, as the cost efficiency is one of competition features in various industries, they introduce cost leadership as another competitive strategy of a company which R&D projects try to make efficient processes by standardization, increase the economy of scale, develop production process and process planning to reduce production costs and offer cheaper high quality products or services to the customers, the known example of such development is Wal-Mart company distribution system (Harisson & Van Hoek, 2011).

The third competition strategy is finding out up-to-date customer requirements and keeping the products align with customer satisfaction level, by study voice of customer deeply, such customer focused methods mostly lead to developing new product lines and trying to implement total customer solution strategy, which bring customer loyalty for the company; It is necessary to mention that this method could be applied only for one or two customer segmentations.

In addition, imitative strategy is described as another competition plan which contains studying competitors' behaviors intensely to obtain their market share rate, customer perceptions, advantages, disadvantages and develop their successful or innovative product immediately. Important feature in this competitive strategy is performing the process rapidly before the satiate

of the market form the product. Furthermore the company should try to use its own innovative ideas in the product to not copying the product; the known example of Samsung tablets against apple ipads could illustrate this competitive strategy obviously (Sener & Davis, 2008).

Subsequently, Liao and Cheung (2002) classify competitive strategies in high tech industries with a customer segmentation focus and marketing insight, into five various strategies: first high added value, which company trying to develop a high value product which could be used widely in the industry and has high commercial value for almost all customer segments. Second is focus on one segment of customers and produce high value added product for them. Third is overall cost leadership as described in Ulrich and Eppinger's (2008) classification that the target of development is to reduce cost of products by various methods for all customer segments. The fourth competitive strategy is to differentiate the product; that the R&D team is seeking to acquire pure innovative idea to absorb almost all customer segmentations, and the last strategy which they describe is to develop innovative product for special customer segmentation.

2.5 Resource Utilization

Resource utilization is the level of used resources capacity like space, labor time and equipment, which illustrates how much the company currently used from its resources potential capabilities and how much of resource capacity is unused (Klassen & Mentor, 2007).

2.5.1 Resource utilization in manufacturing supply chain

Totally the amount of utilization should not be near 100% because it decreases the flexibility of a company; even repeated short term amount of high utilization rate known as a notification of low capacity of a company to keep the capability of resisting against uncertainties (olhager & Johansson, 2012). There are various models for capacity planning like waiting line, simulation and decision trees (Olhager et al., 2001). Consequently, ERP, MRP, BOM and all other resource planning methods and software are useful in this area for supply chain to keep the resource utilization in a balance which leads to neither unused resources nor low flexibilities against uncertainties.

2.5.2 Resource utilization in service sector supply chain

Resource utilization and planning structure in service is more or less the same as manufacturing most of the methods and software which used in manufacturing are modified for services, with some differences, in manufacturing the products according to the forecast should be on shelf or in inventories, whereas in service companies, the forecasts results should be practiced in the capacity of the company. Therefore lots of other concepts have different definition in service companies. All the ERP and MPS systems that were based on the BOM, in service sector are depend on Bill of Resources (BOS), furthermore, in service the role of human factor is very crucial so all the predictions should be done to cover human factors failures, like absence, holiday and other, additionally the utilization planners are mentioned that capacity utilization of human factors could be 100% rarely, and the quality would reduce with more utilization.

2.5.3 Resource utilization in R&D supply chain

Restricted amount of material, time, equipment and human resource, against high number of R&D projects make the companies to allocate resources efficiently, to maximize their utilization and have optimal number of high prioritized innovative projects in progress. Hendriks et al. (1999) emphasize on having unified resource and project pool in the environment to have more R&D projects with less costs.

Wheelwright and Clark (1992) try to allocate resources by "Aggregate Planning" from studying various aspects of project planning and resource allocation. Furthermore some other authors try to create methods to optimal number of in progress projects and their schedule, Platje et al. (1994) study single projects in a unified system of portfolios by "rough-cut-project-and-portfolio-planning" to optimize the number of portfolios based on available resources, moreover, Pillai and Tiwari (1995) suggest a long term procedure for prioritizing the portfolios by the strategic goals of the company, and put less significant projects in the future schedule of R&D teams.

Sometimes the company have to be enough flexible to redirect in accordance with the market fluctuation or competitors behaviors. Therefore, as Hendriks et al. (1999) suggest a model with short, medium and long term resource allocation planning that all these different schedule plans would related to each other by "resource dedication profile " and "project scatter factor", which illustrate situation of resources and projects during time.

3 Synthesis

Table 1. Comparison of R&D sourcing with manufacturing and services supply chains

	Manufacturing	**Services**	**R&D**
input	Capital, material, know-how and labor	capital, material, know-how, the role of labor could be more crucial	Capital, material, labor, but the role of knowledge and information is more critical
output	Finished products, physical or monetary values (like software)	services or additional service to manufactured products	new or developed product, process or activity
Quality	specified in the design of the product or known by quality management approaches	known from customer perceptions and customer expectations and service quality control approaches like SERVQUAL	Quality of concepts should be evaluated by companies policies, market conditions and the process of R&D should access with

	Manufacturing	Services	R&D
			modified Quality Control methods
Cost	cost reduction by efficient production, distribution and optimization whole supply chain	cheap labor, geographical allocation, technological equipment could reduce cost	Totally depends on the contract and strategies, concept and its revenue, which estimated by some methods before and after the beginning of project
Flexibility	Volume, delivery, mix, new product, range respond, flexibilities, some methods like JIT or other strategies like outsourcing could promote it	by allocating human factor and accurate capacity forecasting try to increase flexibility	flexibility of R&D project could be assured by continues evaluation of the project and market situation to continue, modify or abandon the project and avoiding more lost
competitiveness	manufacturing new technologies and best quality or cheap products with acceptable quality or both	more innovative, cheaper services, total customer solution, better employees behavior	technological capabilities, internal infrastructure and knowhow, customer potential and actual needs and market situation
resource utilization	utilization capacity should be synchronized with the production capacity; resource planning with ERP and MPS data bases	utilization capacity calculated with special recognition to the human factors potential; resource planning methods of manufacturing are modified for services	Projects should be prioritized according to the strategy of company, resource planning could be done by shifting or eliminating some project which company does not have enough resources for them.

The syntheses of all the described criteria are shown in table 2. As considered, in manufacturing sector inputs are material, capital, labor and know how. In services supply chain, the inputs are mostly the same with high effectiveness of labors due to more direct connection with customers. Moreover, in R&D supply chain, the inputs are the same with high emphasize on knowledge and information with was known as know-how in those supply chains.

Outputs of manufacturing companies are mostly finished product, not in meaning of ready to use but in the way that the product does not need any other work, although in case of after sale services the chain should be considered as a service supply chain. The outputs of service providers are the activities which are given to customers whether beside manufactured products or without any. In addition the outputs of R&D projects could be divided into two groups of totally new and developed products or services.

Quality is a concept which is defined in the design specification of products and could be assured by Quality management approaches in manufacturing sector. In service sector, quality more than the technical specification, depend on the customer perceptions and expectations which include employees' behavior as well and could be evaluated by some approaches like SERVQUAL. For R&D supply chain, the quality should be evaluated from the first phase of concept selection by strategies and policies of the company and should be followed in other steps as well.

Cost reduction could happen in manufacturing industry is known mostly by existence of efficiency in whole supply chain especially inventories and distribution centers or using from cheaper materials and labors, while in services geographical allocation, cheap labors and technological equipment. Moreover Cost efficiency in R&D project depends on the contracts and strategies of companies in addition to the estimated time and revenue of the projects.

Flexibility could be divided into various classifications to ease to promote by different methods like JIT. In service companies appropriate resource allocation and accurate capacity forecast could increase it. While in R&D supply chains, the project members should evaluate the project and market situations to continue, modify or abandon the project and avoid from more loos of the company.

Competitiveness strategies in manufacturing supply chain is mostly based on the cost, technology or both, therefore the company should represent the best quality, the cheapest product or combination of both. The situation in service company is more or less the same plus the bold role of employees and human factors behavior which could be paramount of a service provider, additionally in R&D sector the company could compete by best technological capabilities, cost leader ship strategy or customer focused developed product although combination of these strategies are possible as well.

Resource utilization and allocation are calculated by almost the same methods in manufacturing and services supply chains, but in R&D the projects should be prioritized be the strategic plans of the company.

CONCLUSION

In accordance with the mentioned difference and similarities of various sourcing networks, some approaches have been modified from one sectors supply chain to the other, while for more

accurate structures, more specifications should be studies. The usage of the study is mostly in those mentioned issued which give a brief landscape from different sectors supply chains.

Table. 1 could be the answer of research question in investigated criteria, inputs and outputs of R&D are almost the same as services and manufacturing with the difference of knowledge and date critical role in the R&D add value network. Quality in R&D should be defined from the first phase of concept selection and it should be assured during the other phases the same as two other sectors sourcing quality assurance approaches, although the whole concept of the project should be under continues evaluation.

Cost efficiency is more complex in R&D supply chain due to vague result of the process and the market situation in the future. Additionally the processes should be under assessment in all parts of the processes to keep the flexibility and avoid from loos in case of bad market situation or wrong direction of the R&D supply network players.

R&D is one of competitiveness tools in case of accuracy, the classification of high quality and low cost are the aim of R&D projects by using from innovation, supreme technologies or creative logistic methods for cost reduction. Resource allocation is defined the same in R&D sector and manufacturing and service companies with the difference on the prioritization policies which the company should define according to its strategies and market situation.

REFERENCES

1. Allon, G. & Federgruen, A. January/February 2007, "Competition in Service Industries", *Operations research,* vol. 55, no. 1, pp. 37-55.
2. Altiok, T. & Ranjan, R. (1995), “Multi-stage, pull-type production/ inventory systems”, *IIE Transactions,* Vol. 27, pp. 190-200.
3. Amrine, H.T., Ritchey J.A., Moodie C.L. and Kmec, J.F. (1993), *Manufacturing Organization and Management*, 6th ed. Englewood Cliffs, NJ, Prentice-Hall.
4. Aranda, D.A. (2003), "Service operations strategy, flexibility and performance in engineering consulting firms", *International Journal of Operations & Production Management,* Vol. 23, No. 11, pp.1401 - 21.
5. Arze, E.C. & Svensson, B.W. (1997), “Development of international competitiveness in industries and individual firms in developing countries: The case of the Chilean forest-based industry and the Chilean engineering firm Arze, Recin´e and Asociados” , *International Journal of Production Economy*, Vol. 52, pp. 185-202.
6. Beamon, B.M. (1998), "Supply chain design and analysis: Models and methods", *International Journal of Production Economics,* vol. 55, no. 3, pp. 281-294.
7. Beamon, B.M. (1999),"Measuring supply chain performance", *International Journal of Operations & Production Management*, Vol. 19, No.3, pp. 275– 292.
8. Benner, M.J. and Tushman, M. L. (2003), “Exploitation, exploration, and progress management: the productivity dilemma”, *Academy Management Review,* Vol. 28, pp. 238-56.
9. Bolton, R.N. and Drew, J.H. (1991), "A longitudinal analysis of the impact of service changes on customer attitudes", *The Journal of Marketing*, pp. 1-9.

10. Camm, J.D., Chorman, T.E., Dill, F.A., Evans, J.R., Sweeney, D.J. and Wegryn, G.W. (1997), "Blending OR/MS, judgment, and GIS: Restructuring P&G's supply chain", Interfaces, Vol. 27, No. 1, pp. 128-142.
11. Carmignani, G. (2009), "Supply chain and quality management: The definition of a standard to implement a process management system in a supply chain", *Business Process Management Journal*, Vol. 15, No. 3, pp. 395 – 407.
12. Carmon, Z., Shanthikumar, J.G., Carmon T.F. (1994), "A Psychological perspective on service segmentation: The significance of accounting for consumers perception of Waiting and Service", *Management Science*, Vol.41, pp.1806- 1815.
13. Chambers, S. (1992), "Flexibility in the context of manufacturing strategy", in Voss, C.A. (Eds), *Manufacturing Strategy. Process and Content*, Chapman and Hall, London.
14. Chiang, K. & Shiang-Tai, L. (1999), "Competitiveness of manufacturing firms: an application of fuzzy weighted average", *Systems, Man and Cybernetics, Part A: Systems and Humans, IEEE Transactions on,* Vol. 29, No. 6, pp. 661-667.
15. Christopher, M. 1992, *Logistics and Supply Chain Management*, Pitman Publishing, London.
16. Cleveland, G., Schroder, R.G., and Anderson, J.C. (1989), "A theory of production competence," *Decision Science.*, Vol. 20, No. 4, pp. 655-688.
17. Cole, R. (2011), "What Really Happened to Toyota", *Sloan management review,* Vol. 52, No. 4, pp. 29-35.
18. Cohen, M.A. and Lee, H.L. (1988), "Strategic analysis of integrated production-distribution systems: Models and methods", *Operations Research,* Vol.36, No. 2, pp. 216-228.
19. Cooper, R.G., Kleinschmidt, E.J. (1994), "Determinants of timeliness in product development", *Journal of Product Innovation Management,* Vol. 11, No. 5, pp. 381-396.
20. Dabholkar, P.A. 1996, "Consumer evaluations of new technology-based self-service operations: an investigation of alternative models", *International Journal of Research in Marketing*, vol. 13, no. 1, pp. 29-51.
21. D'Souza, D.E. & Williams, F.P. (2000), "Toward a taxonomy of manufacturing flexibility dimensions", *Journal of Operations Management*, Vol.18, No.5, pp577-93.
22. Dunk, A.S. & Kilgore, A. (2001), "Short-term R&D bias, competition on cost rather than innovation, and time to market", *Scandinavian Journal of Management*, Vol. 17, No. 4, pp. 409-420.
23. Ellram, L.M., Tate, W.L. & Billington, C. (2004), "Understanding and Managing the Services Supply Chain", *Journal of Supply Chain Management*, Vol. 40, No. 4, pp. 17-32.
24. El Mhamedi, A. and Binder, Z. (1992), "Socio-technical design and evaluation of production systems," *International Journal of Systems Science*, Vol. 23, No. 7, pp. 1141-1154.
25. Fish, L.A. (2011), "Supply chain management pathways for research & practice", *Intech*.
26. Frei, F.X. (2006), "Breaking the trade-off between efficiency and service", *Harvard business review*, Vol. 84, No. 11, pp. 92.
27. Feurer, R., Chaharbaghi, K. (1994), "Defining Competitiveness: A Holistic Approach", *Management Decision*, Vol. 32, Iss: 2, pp.49 – 58.
28. Gardiner L.R., & Gardiner S.C. (1997), "A framework of the systemic control of organizations," *International Journal of Production Research*, vol. 35, no. 3, pp. 597-609.
29. Grönroos, C. (1988), "Service quality: the six criteria of good service quality", *Review of Business*, Vol. 9, No. 3, pp. 10-13.

30. Gupta, Y.P. and Somers, T.M. (1996), "Business strategy, manufacturing flexibility, and organizational performance relationships: a path analysis approach", *Production and Operations Management*, Vol. 5 No.3, pp. 204-31.
31. Haywood-Farmer, J. (1988), "A conceptual model of service quality", *International Journal of Operations & Production Management*, Vol. 8, No. 6, pp. 19-29.
32. Harrison, A. & Van Hoek, R. (2011), *logistics management & strategy competing through the supply chain*, fourth edition, Financial Times Press.
33. Heshmati, A. (2003), "Productivity Growth, Efficiency and Outsourcing in Manufacturing and Service Industries", Journal of Economic Surveys, Vol. 17, No. 1, pp.79-112.
34. Hendriks, M., Voeten, B. & Kroep, L. (1999), "Human resource allocation in a multi-project R&D environment: Resource capacity allocation and project portfolio planning in practice", International Journal of Project Management, Vol. 17, No. 3, pp. 181-188.
35. Huang, S.H., Uppal, M., & Shi, J. (2002), "A product driven approach to manufacturing supply chain selection", *Supply Chain Management,* Vol.*7,* No. 3, pp. 189-199.
36. Huchzermeier, A. and Loch, C.H. (2001), "Project Management Under Risk: Using the Real Options Approach to Evaluate Flexibility in R… D", Management Science, Vol. 47, No. 1, pp. 85-101.
37. Kim, J.S. and Arnold, P. (1993), "Manufacturing competence and business performance: A framework and empirical analysis," *International. Journal of Operation Management*, Vol. 13, No. 10, pp. 47–61.
38. Klassen, R.D., Menor, L.J. (2007), "The process management triangle: An empirical investigation of process trade-offs", *Journal of Operations Management*, Vol. 25, No. 5, pp. 1015-1034.
39. Kuei, C., Madua, C. & Lin, C. (2008), "Implementing Supply Chain Quality Management". *Total Quality Management*, Vol. 19, No. 11, pp. 1114-1127.
40. Iravani, S.M., Van Oyen, M.P. & Sims, K.T. (2005). "Structural Flexibility: A New Perspective on the Design of Manufacturing and Service Operations," *Management Science*, Vol. 51, No.2, pp. 151-166.
41. Ishii, K., Takahashi, K., Muramatsu, R. (1988), "Integrated production, inventory and distribution systems", *International Journal of Production Research*, Vol.26, No.3, pp. 473-482.
42. Johnston, R., Glark, G. (2008), *Service operations and management*, (3rd ed.),Prentice Hall, Harlow.
43. Jonrinaldi and Zhang, D.Z. (2013), "An integrated production and inventory model for a whole manufacturing supply chain involving reverse logistics with finite horizon period", *Omega,* Vol. 41, No. 3, pp. 598-620.
44. Koste, L.L. & Malhotra, M.K. (1999), "A theoretical framework for analyzing the dimensions of manufacturing flexibility", *Journal of Operations Management*, Vol.18, No.1, pp75-93.
45. Lee, H.L., Billington, C., Carter, B. (1993), "Hewlett-Packard gains control of inventory and service through design for localization", *Interfaces*, Vol.23, No.4, pp.1-11.
46. Lee, H.L., Feitzinger, E. (1995), "Product configuration and postponement for supply chain efficiency", *Fourth Industrial Engineering Research Conference Proceedings, Institute of Industrial Engineers*, pp. 43-48.

47. Liao, Z. & Cheung, M.T. (2002), "Do competitive strategies drive R&D?: An empirical investigation of Japanese high-technology corporations", *The Journal of High Technology Management Research,* Vol. 13, No. 2, pp. 143-156.
48. Lööf, H. and Heshmati, A. (2002), "Knowledge capital and performance heterogeneity: a firm-level innovation study", *International Journal of Production Economics*, Vol. 76, No. 1, pp. 61–85.
49. Malhotra, M.K. and Robinson, C.J. (2005), "Defining the concept of supply chain quality management and its relevance to academic and industrial practice", *International Journal of Production Economics*, Vol. 96, pp. 315-37.
50. Menke, M.M. (1991), "Tools for improving the quality of R&D management", Technology Management: the New International LanguageIEEE, , pp. 162.
51. Olhager, J. & Johansson, P. (2012), "Linking long-term capacity management for manufacturing and service operations", *Journal of Engineering and Technology Management,* Vol. 29, No. 1, pp. 22-33.
52. Olhager, J., Rudberg, M. and Wikner, J. (2001), "Long-term capacity management: Linking the perspectives from manufacturing strategy and sales and operations planning", *International Journal of Production Economics,* Vol. 69, No. 2, pp. 215-225.
53. Parasuraman, A., Zeithaml, V.A. and Berry, L.L. (1985), "A conceptual model of service quality and its implications for future research", *Journal of Marketing*, Vol. 49, No. 4, pp. 41-50.
54. Pillai, A.S. and Tiwari, A. (1995), "Enhanced PERT for programme analysis, control and evaluation: PACE*", International Journal of Project Management*, Vol. 13, No. 1, pp. 39-43.
55. Platje, A., Seidel, H. & Wadman, S. (1994), "Project and portfolio planning cycle. Project-based management for the multiproject challenge*", International Journal of Project Management*, Vol. 12, No. 2, pp. 100-106.
56. Porter, M.E. (2000), "Location, Competition, and Economic Development: Local Clusters in a Global Economy", Economic Development Quarterly, Vol. 14, No. 1, pp. 15-34.
57. Prajogo, D.I. and Sohal, A.S. (2001), "TQM and innovation: a literature review and research framework", *Technovation,* vol. 21, no. 9, pp. 539-558.
58. Pyke, D.F., Cohen, M.A. (1994), "Multi-product integrated production- distribution systems", *European Journal of Operational Research*, Vol. 74, No.1, pp.18-49.
59. Roberts, K., Weitzman, M.L. (1981), "Funding criteria for research, development, and exploration projects", *Econometric Society,* Vol. 49, pp. 1261-1288.
60. Rosko, M.D. (2001), "Cost efficiency of US hospitals: a stochastic frontier approach", *Health Economics*, Vol. 10, No. 6, pp. 539-551.
61. Santiago, L. P., & Vakili, P. (2005),"On the value of flexibility in R&D projects." *Management Science*, Vol. 51, No. 8, pp. 1206-1218.
62. Santos, J. (2003), "E-service quality: a model of virtual service quality dimensions", *Managing Service Quality*, Vol. 13, No. 3, pp. 233-46.
63. Schwartz, E. S., & Trigeorgis, L. (2004), *Real options and investment under uncertainty: Classical readings and recent contributions*. The MIT Press.
64. Sener, M.F. and Davis, L.S. (2008), "Scientists and Lawyers: Innovation, Imitation and Growth with Endogenous Patent Protection".

65. Sethi, A.K., Sethi, S.P. (1990), "Flexibility in manufacturing: a survey", *International Journal of Flexible Manufacturing Systems*, Vol.2, No.4, pp289-328.
66. Siegel, D., and Griliches, Z. (1992), "Purchased services, outsourcing, computers, and productivity in manufacturing". in Griliches, Z. (Ed.), *Output Measurement in Service Sector*, University of Chicago Press, Chicago, IL.
67. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E. (2007), *Designing & Managing the Supply Chain*, 3rd Edition, McGraw-Hill.
68. Slack, N. (1983), "Flexibility as a manufacturing objective", *International Journal of Operations and Production Management*, Vol.3, No.3, pp4-13.
69. Slack, N. (1991), *The Manufacturing Advantage*, Mercury Books, London.
70. So, K.C. (2000), "Price and Time Competition for Service Delivery", *Manufacturing & Service Operations Management,* Vol. 2, No. 4, pp. 392-409.
71. Suarez, F.F., Cusumano, M.A., Fine, C.H. (1996), "An empirical study of manufacturing flexibility in printed circuit board assembly", *Operations Research*, Vol. 44, No.1, pp. 223-40.
72. Thoma, B. & O'Sullivan, D. (2011), "Study on Chinese and European automotive R&D – comparison of low cost innovation versus system innovation", Procedia - Social and Behavioral Sciences, Vol. 25, No. 0, pp. 214-226.
73. Towill, D.R., Del Vecchio, A. (1994), "The application of Filter Theory to the study of supply chain dynamics", *Production Planning and Control,* Vol. 5, No. 1, pp. 82-96.
74. Tzafestas, S., Kapsiotis, G. (1994), "Coordinated control of manufacturing/ supply chains using multi-level techniques*", Computer Integrated Manufacturing Systems,* Vol. 7, No. 3, pp. 206-212.
75. Ulrich, K. T., & Eppinger, S. D. (2008). *Product design and development* (Vol. 384). New York: McGraw-Hill.
76. Vickery, S.K., Droge, C., and Markland, R.E. (1991), "Production competence and business strategy: Do they affect business performance?", *Decision Sciences*, Vol. 24, No. 2, pp. 436-455.
77. Wang, J., Hsu, J.T.S. and Bhatia, A.C. (2012), "Expanding the Role of the iPad and Tablet Devices to Cosmetic Patient Consultations", Seminars in cutaneous medicine and surgery, Vol. 31, No. 3, pp. 200-202.
78. Wheelwright, S.C. and Clark, K.B. (1992), *Revolutionary Product Development*. The Free Press, New York.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

A CONCEPTUAL MODEL OF CORPORATE ENTREPRENEURSHIP IN BANKING INDUSTRY

Bobby Boon-Hui Chai, Faculty of Business & Finance, Universiti Tunku Abdul Rahman (UTAR) Malaysia
bobbybhchua@gmail.com

Harry Entebang, Faculty of Economics & Business, Universiti Malaysia Sarawak (UNIMAS), Malaysia

ABSTRACT

***Purpose**: The rapid growth of global economies, changes in technology, market competition and ever changing business environment have caused the banks to struggle for profitability, growth and performance.*
With the intense competition among banks in the industry, it is imperative for them to have superior performance, and the banks have attempted to implement and use various initiatives such as: TQM, BPR, SP, Six Sigma, Balanced Scorecard, ABM. However, banks being the backbone of any economy and its importance for the future growth and development of the country. Thereby, the performance of the bank is of a major concern, and with this in mind the scholars have argued that there is a strong relationship between corporate entrepreneurship (CE) and bank performance. Therefore, corporate entrepreneurship with innovative products, strategic renewal and quality services will provide the banks with competitive advantages in the organization, sustaining them in their business challenges and survival in the market place with greater performance.
***Design/methodology/approach:** Conceptual paper*
***Findings and implications:** Conceptual paper*
***Originality/value**: The study is important to decision maker in the banking industry*

Keywords: Bank, Performance, Corporate Entrepreneurship

INTRODUCTION

The bank by definition is a financial intermediary that accepts and channels deposits into loan activities and their objective is to connect the customers with capital deficits to customers with capital surpluses.

The rapid changes in technology, increase in globalization and market competition have caused organizations to struggle for profitability and growth.

The consumer's choice on products and competitive strategy among the banks are almost the same as there is no corporate innovation, the study also revealed that referral from friends or family is very important to the customer.

In order to survive and prosper in the banking industry, the banks need to become more entrepreneurial (Lumpkin and Dess 1996; Thornberry 2001). Entrepreneurial firms/organizations tend to do better than those that are less entrepreneurial (Miller, 1983). This study proposes that a corporate entrepreneurship firm may affect its innovation performance.

LITERATURE REVIEW

Entrepreneurship can be defined as important steps in promoting and keeping the business to have a competitive advantages in their respective business or related industry (Covin & Miles, 1999), and hence it will improve its overall effectiveness and performance.

In order to enhance the performance of the banking industry, the banks should incorporate corporate entrepreneurship in the banking industry as it plays a very key role in the economy of both in the developed world as well as in developing economies. Thus, understanding corporate entrepreneurship in the banking industry should not be ignored. It is noted that past empirical work has extensively examined the corporate entrepreneurship on firms' financial performance.

With the understanding of "What is corporate entrepreneurship (Zahra, 1993)", and with the above reasons, this proposal thus aims to lead towards a study in supporting the main objective: to examine the enhancement of corporate entrepreneurship strategy and organizational performance for banking industry.

Corporate entrepreneurship or intrapreneurship refers to entrepreneurial activities within existing business organizations (Schollhammer, 1982). Likewise, Zahra (1995) views Corporate Entrepreneurship as the sum of a company's innovation, renewal, and venturing activities.

CE is further defined as the process whereby an individual or a group of individuals, in association with an existing organisation, create a new organisation or instigate renewal or innovation within that organisation (Sharma & Chrisman, 1999).

In this paper, we define CE as strategic organisational innovation, strategic renewal and corporate venturing initiatives or activities and its environment to achieved bank performance.

PROPOSITION DEVELOPMENT

In order to achieve the proposed objectives, the following hypotheses were developed for testing;

- P1 That corporate entrepreneurship will be positively associated with innovation performance in banks

- P2 That external corporate entrepreneurship factors will moderate the relationship between corporate environment and innovation performance in banks

Innovation

The success and survival of entrepreneurs are further enhance by their innovation in their product and process innovation (Huang & Wang, 2011). Corporate entrepreneurship has demonstrated in terms of innovation, strategic renewal & corporate venturing (Zahra, 1993). Innovation is key to competitive advantage (Zahra 1991 & 1993)

Corporate Venturing

As a safety precaution and for the growth of corporation. It is vital that the corporation has to further improve their overall corporate entrepreneurship strategy by upgrading their operational capability and to seek opportunities in corporate venturing as it has to compete in different corporate environment, and also to implement effective activities in order to face the highly successful corporation (Ferreira, J. 2002).

Environment

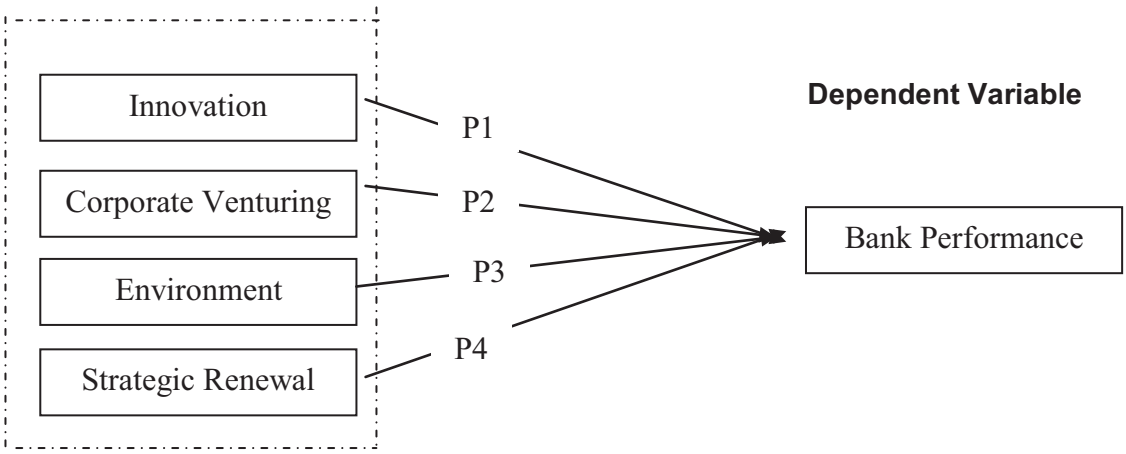
The hostility of the environment is one of the most dangerous external forces that affect firms' entrepreneurial performance (Covin & Slevin, 1991a; Zahra, 1991). Past studies had shown that hostility can have a significant impact on the CE-performance (Zahra & Covin, 1995). Changes in industry, intense regulation, fierce rivalry among competitors (Werner, Brouthers & Brouthers, 1996); competitive market, and product-related uncertainties (Dess & Beard, 1984).

Strategic Renewal

The process that attribute to the outcomes by driving and transforming the bank to survive and sustained in the long term through their creativity by identifying new venture.
(Agarwal R. and , Helfat 2009*)*

PROPOSED MODEL OF CORPORATE ENTREPRENEURSHIP FOR BANKING INDUSTRY

In order to examine the relationship between Innovation, Corporate Venturing, Environment and Strategic Renewal with Bank Performance, Covin & Slevin (1991a) had shown that the characteristics of a good model should show the performance of bank as the ultimate dependent variable, the independent variables are clearly defined. Therefore, the relationship between independence variables and dependent variable can be shown in the conceptual model as follows:



IMPLICATIONS, LIMITATION & FUTURE STUDIES

The key aspects of Corporate Entrepreneurship and the effects are of great magnitudes to the corporate performance.

Top management support has been found to have a positive relationship with new product performance and the empowerment of employees that facilitate and promote entrepreneurial behavior, that provide innovative ideas and the resources towards achieving good financial performance in banking industry.

The limitations were noted because the results and the findings of the present study were from main branches of the banks. Therefore, this may limit the generalisability of this study.

Corporate Entrepreneurship not only contributes to companies' financial performance but also innovation activities i.e. non-financial performance of a firm

Future study may also examine, the effects of Corporate Entrepreneurship on the financial performance of banks and also the effects of Corporate Entrepreneurship initiatives on the financial performance of banks.

The study is believed to be able to contribute significantly to the Corporate Entrepreneurship of research literature, by helping quality practitioners and academicians to better understand the relationship between Corporate Entrepreneurship, corporation performance among banking industry in structural relationships.

CONCLUSION

In summary, this paper attempts to enhance the performance by conducting a thorough finding of the corporate strategy between corporate entrepreneurship and banking industry. The management may learn that the ability to exert proactiveness, innovativeness and risk-taking behaviour would determine the extent of which their organisations will pursue innovation initiatives/activities. The banks may observe that the dimension of the external organisational factors will be strong and significant to their innovative activities.

REFERENCES

1. Covin, J. G., & Slevin, D. P. (1991). A conceptual model of entrepreneurship as firm behavior *Entrepreneurship Theory and Practice, 16*(1), 7-26.
2. Covin, J. G. & Miles M.P. , E. W. (1999), Corporate entrepreneurship and the pursuit of competitive advantage. Entrepreneurship: theory and practice, 23 (3), 47-57.
3. Dess, G., & Beard, D. (1984). Dimensions of organizational task environments. *Administrative Science Quarterly, 29*, 52-73.
4. Ferreira, J. (2002), Corporate Entrepreneurship: A Strategic and Structural Perspective. ICSB, World Conference, Puerto Rico.
5. Huang, K. S. & Wang Y.L. (2011, Entrepreneurship and Innovation: A Review of the Theory and Literatures. IPEDR vol.7, IACSIT Press, Singapore.
6. Lumpkin, G. T., & Dess, G. G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *The Academy of Management Review, 21*(1), 135-172.
7. Miller, D. (1983). The correlates of entrepreneurship in three types of firms. *Management Science, 29*(7), 770-791.
8. R. Agarwal, (2009) "Strategic renewal of organizations", Strategic Direction, Vol. 25 Iss: 10, pp. -
9. Schollhammer, H. (1982). Internal corporate entrepreneurship. In C. A. Kent, D. L. Sexton & K. H. Vesper (Eds.), *Encyclopedia of entrepreneurship*
10. Sharma, P., & Chrisman, J. J. (1999). Toward a reconciliation of the definitional issues in the field of corporate entrepreneurship. *Entrepreneurship Theory and Practice, 23*(3), 11-27.
11. Thornberry, N. (2001). Corporate entrepreneurship: antidote or oxymoron? *European Management Journal, 19*(5), 526-533.
12. Zahra, S. A. (1993). Environment, corporate entrepreneurship and financial performance: A taxomomic approach. *Journal of Business Venturing, 8*, 318-340.
13. Zahra, S. A. (1991). Predictors and financial outcomes of corporate entrepreneurship: An exploratory study. *Journal of Business Venturing, 6*, 259-286.
14. Zahra, S. A. (1995). Corporate entrepreneurship and financial performance: The case of management leveraged buyouts. *Journal of Business Venturing, 10*, 225-247.

AUTHOR BIOGRAPHIES

Mr. Bobby Boon-Hui Chai is the Head of Marketing Department at the Faculty of Business and Finance, Universiti Tunku Abdul Rahman, Malaysia. He obtained his Master of Business Administration (Strategic Marketing) from the University of Hull, UK and Diploma in Marketing, The Chartered Institute of Marketing, UK. He is a Fellow of The Chartered Institute of Marketing, UK, and Member of The Institute of Marketing, Malaysia. A Registered Financial Planner (RFP), and a Certified Financial Planner (CFP), Malaysia. Email: bobbybhchua@gmail.com

Dr. Harry Entebang is a Senior Lecturer at the Faculty of Economics & Business & Head of Intellectual Property Management & Commercialization, Centre for Technology Transfer & Consultancy (CTTC), Universiti Malaysia Sarawak (UNIMAS). Prior to joining UNIMAS, he worked for the Sarawak state government agencies for 11 years. His areas of expertise include accounting & financial management, financial/economic performance analysis, organizational strategic planning, innovation, strategic renewal, corporate entrepreneurship, and credit management. He has published locally and internationally in refereed journals while actively involves in various training and consultancy services.
Email: harryentebang@yahoo.com

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

EXTENDING THE UTAUT MODEL IN M-BANKING ADOPTION

Ching-Mun Cheah, Universiti Tunku Abdul Rahman, Malaysia, Faculty of Business and Finance
cheahcm@utar.edu.my

Aik-Chuan Teo, Universiti Tunku Abdul Rahman, Malaysia, Faculty of Business and Finance
teoac@utar.edu.my

Keng-Boon Ooi, Linton University College, Malaysia, Chancellery Division
ooikengboon@gmail.com

Jessica C.J. Wong, Linton University College, Malaysia, Chancellery Division
jessicawcj@gmail.com

ABSTRACT

The banks are motivated to leverage their m-banking activities with the advancement of mobile technologies and the high mobile penetration rate. Despite the availability of the m-banking services, many consumers still posses the attitude of 'wait-and-see' which resulted to unsatisfactory adoption rate. Hence, this paper aims to extend the Unified Theory of Acceptance and Use of Technology (UTAUT) model to better understand what drives Malaysian consumers to adopt m-banking services. The conceptual model also provide better strategic insights for commercial banks, service developers, mobile manufacturers, and others to yield higher acceptance of m-banking.

Keywords: M-Banking, Adoption, Unified Theory of Acceptance and Use of Technology (UTAUT), Malaysia

INTRODUCTION

Gone were those days, where banking transactions traditionally only performed via bank branches, Automated-Teller Machine (ATM), telephone and online platforms. With the convergence of internet, wireless technologies, and mobile advancement, the new form of banking has emerged, namely, mobile banking. Mobile banking is defined as a channel whereby the customer interacts with bank using mobile device (i.e., mobile phone and Personal Digital Assistant) (Barnes & Corbitt, 2003). Along with the different sectors, banking sector is the leading sector in utilizing both internet and mobile technology in delivering its services (Laukanen, 2007).

Considering the high mobile penetration rate, Pousttchi & Schurig (2004) foresee that m-banking will appear as the most typical applications in m-commerce. However, the current acceptance of m-banking still remains at infancy stage (Sulaiman et al., 2007, Donner & Tellez, 2008, Cheah et al., 2011). Kleijnen et al. (2007) also stated that the m-banking usage is still far from meeting the industry expectation. To further support this, Bank Negara Malaysia (2012) has reported that only a slight increase of 1.7 penetration rate of m-banking

among the mobile subscribers from year 2011 to 2012. Thus, it is not surprising that examining the acceptance and rejection of innovation has emerged as one of the most emphasized areas in innovation research.

Many studies has been conducted to examine the adoption of m-banking (Cheah et al., 2011; Zhou et al., 2010; Sulaiman et al., 2007) through various models such as Technology Acceptance Model (TAM) (Cheah et al., 2011), integrated model of Task-Technology-Fit and Unified Theory of Acceptance and Use of Technology (UTAUT), and Innovation Diffusion Theory (IDT). Puschel et al. (2010) commented that different IS models used will produce different results which make it difficult for scholars to compare the findings. As UTAUT explains 70% of the variance in explaining users' intention (Venkatesh et al., 2003), thus, the study aims to further extend UTAUT model with the inclusion of two additional, namely, trust and perceived value (PV). The paper begins with the introduction, followed by the proposed conceptual research framework and hypothesis development. Lastly, the paper ends with the conclusion and implications.

LITERATURE REVIEW

Unified theory of Acceptance and Use of Technology (UTAUT)

Drawing from TAM, UTAUT was proposed by Venkatesh et al. (2003). Based on the model, both user adoption and usage of IT are affected by four constructs, namely, performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC). UTAUT was built after the reviewing the eight renowned IS theories consisting the Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), the Innovation Diffusion Theory (IDT), the Motivational Model, the PC Utilization Model, the Social Cognitive Theory (SCT), and the integrated model of technology acceptance and planned behavior. Even though the UTAUT model has not been widely adopted in comparison with the other IS models such as TAM (Zhou et al., 2010), but it has gradually drawn several researchers' attention such as Chong (2012) and Gruzd et al., (2012) to adopt the model to investigate adoption of mobile innovations.

UTAUT

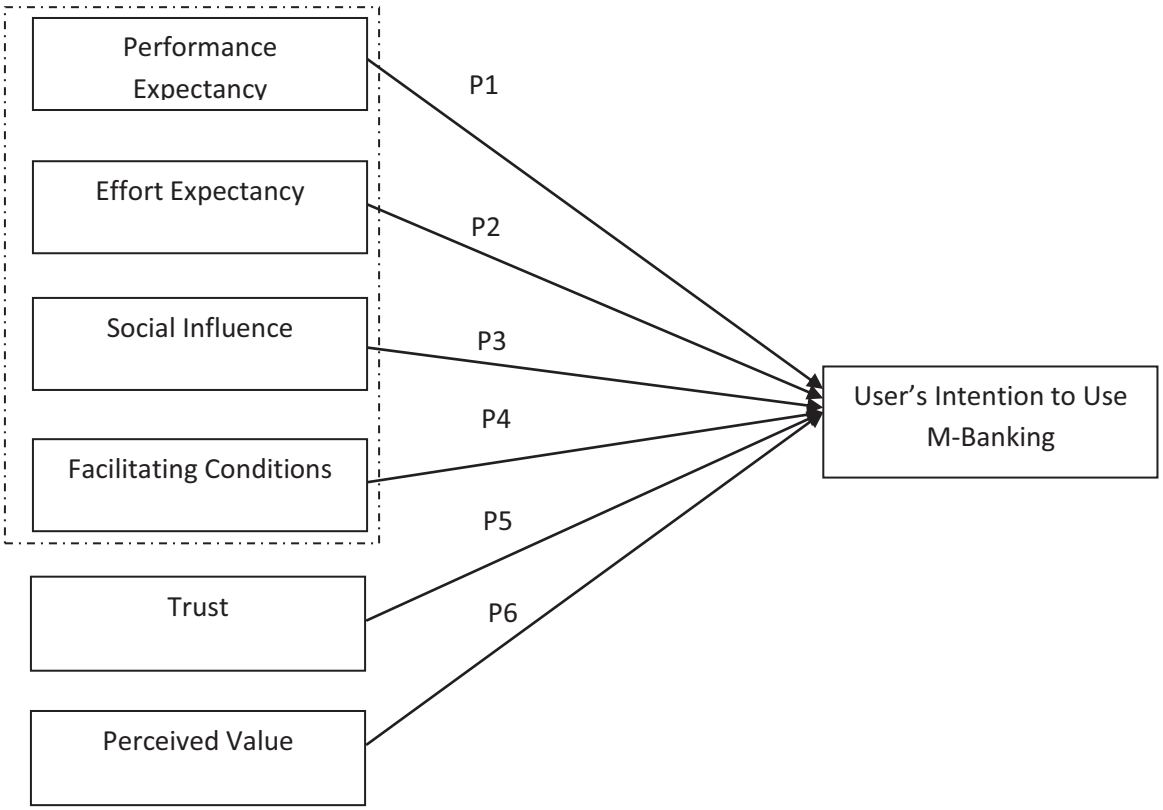


Figure 1: Conceptual Research Framework extent

Hypothesis Development

Performance expectancy (PE) refers to the degree of utilizing an information system (IS) which will provide benefits to the users. PE is conceptually similar to the construct of perceived usefulness and relative advantage from TAM and Innovation Diffusion Technology (IDT) respectively (Venkatesh et al., 2003). Acknowledging the similarity, Brown et al. (2003) denoted that the higher the perceived relative advantages, the greater behavioral intention to adopt m-banking. Effort expectancy (EE) refers to the extent of ease associated with the use of IS. The construct is parallel to perceived ease of use of TAM and complexity of IDT (Venkatesh et al., 2003). In the case of m-banking, users will more likely to use m-banking service if using the service is free from effort and easy to use. Recognizing the important of social influence (SI), Pederson & Ling (2002) indicated that the construct cannot be simply ignored in any innovation adoption studies. Similar to the construct of subjective norm of TRA, SI refers to the extent to which users perceived the importance of others like family & friends' believe that they should utilize the IS (Venkatesh et al., 2003). This simply implies that the social pressures would drive the individual to adopt m-banking services. Facilitating condition (FC) refers to the consumers' perceptions to the resources and support which individuals received when using IS. Zhou et al. (2010) indicated that the users will only adopt m-banking services if they have both financial resources and operational skills. Drawing from the review of literatures, we formulated the following propositions:

P1: PE has positive significant relationship towards Malaysian's m-banking adoption.
P2: EE has positive significant relationship towards Malaysian's m-banking adoption.
P3: SI has positive significant relationship towards Malaysian's m-banking adoption.
P4: FC has positive significant relationship towards Malaysian's m-banking adoption.

In the mobile environment, trust plays a critical role as it involves high degree of uncertainties and risks (Lin et al., 2012). Furthermore, personal information such as contacts is usually stored in users' mobile devices which may lead to relatively high security and privacy risks. Kim & Prabhakar (2004) further supported that the trust has significant influence towards new technologies adoption. Perceived value (PV) is defined as the user's overall perception of m-commerce according to the considerations of the benefits and scarifies needed to acquire and/or use it (Kim, 2007). Chong (2013) through the survey conducted from 140 respondents in China as found that the PV is the critical factor of m-commerce adoption. Hence, the following propositions are postulated:

P5: SI has positive significant relationship towards Malaysian's m-banking adoption.
P6: FC has positive significant relationship towards Malaysian's m-banking adoption.

CONCLUSION AND IMPLICATIONS

The conceptual paper of extended UTAUT examined the determinants of m-banking adoption by adding constructs such as trust and PV. There are several impacts identified from this study which are derived from the original UTAUT model, but this study has also further extended into the perspective of consumers' information system adoption. As such, it provides better understanding on what drives the user's m-banking adoption. Secondly, this study has investigated the adoption of m-banking in developing country, particularly, Malaysia. As mobile devices is relatively important in Malaysian's routines in comparison to North America and Europe as mobile devices play a significant role in Malaysian's routines as compare to North America and Europe (Boer and Boer, 2009), hence, the paper will be beneficial to banks, system engineers, and other service providers in formulating and implementing strategic move to boost the use of m-banking in Malaysia.

REFERENCES

1. Bank Negara Malaysia (2013), "Internet banking and mobile banking subscribers", available at: http://www.bnm.gov.my/statistics/payment/pdf/04_internet_banking_20120604.pdf [accessed 12 February 2013].
2. Barnes, S. J. (2003), "Mobile banking: concept and potential", *International Journal of Mobile Communications*, Vol. 1 No. 3, pp. 273-288.
3. Boer, R., and Boer, T. (November, 2009), "Mobile payments: market analysis and overview", *Innopay,* available at:
4. https://www.nacha.org/userfiles/File/The_Internet_Council/Resources/Mobile%20payments%202010%20-%20Innopay.pdf [accessed 15 April 2012].

5. Brown, I, Cajee, Z., Davies, D. and Stroebel, S. (October, 2003), "Cell phone banking: predictors of adoption in South Africa – an exploratory study", *International Journal of Information Management*, Vol. 23 No. 5, pp. 381-394.

6. Cheah, C. M., Teo, A. C., Sim, J. J., Oon, K. H., and Tan, B. I. (September, 2011), "Factors affecting Malaysian mobile banking adoption: an empirical analysis", *International Journal of Network and Mobile Technologies*, Vol. 2 No. 3.
7. Chong, A. Y. L. (1 February, 2013), "Predicting m-commerce adoption determinants: a neural network approach", *Expert systems with Applications*, Vol. 40 No. 2, pp. 523-530.
8. Chung, N., and Kwon, S. J. (2009), "The effects of customers' mobile experience and technical support on the intention to use mobile banking", *Cyber Psychology and Behavior*, Vol. 12 No. 5, pp. 539-543.
9. Donner, J., and Tellez, C. A. (2008), "Mobile banking and economic development: linking adoption impact and use", *Asian Journal of Communication*, Vol. 18 No. 4, pp. 318-332.
10. Gruzd, A., Staves, K., and Wilk, A. (November, 2012), "Connected scholars: examining the role of social media in research practices of faculty using the UTAUT model", *Computers in Human Behavior*, Vol. 28 No. 6, pp. 2340-2350.
11. Kim, K. K., and Prabhakar, B. (2004), "Initial trust and the adoption of B2C e-commerce: the case of internet banking", *Database for Advances in Information Systems*, vol. 35 No. 2, pp. 50-64.
12. Kim, H.W., Chan, H.C., and Gupta, S. (2007), "Value-based adoption of mobile internet: an empirical investigation", *Decision Support Systems*, Vol. 43 No. 1, pp. 111-126.
13. Kleijnen, M., De Ruyter, K. and Wetzels, M. (2007), " An assessment of value creation in mobile service delivery and the moderating role of time consciousness", *Journal of Retailing*, Vol. 83 No. 1, pp. 33-46.
14. Laukkanen, T. (2007), "Internet vs. mobile banking comparing customer value perceptions", *Business Process Management Journal*, Vol. 13 No. 6, pp. 788-797.
15. Lin, J., Lu, Y., Wang, B., and Wei, K. K. (2011), "The role of inter-channel trust transfer in establishing mobile commerce trust", *Electronic Commerce Research and Applications*, Vol. 10 No. 6, pp. 615-625.
16. Pederson, P, and Ling, R. (2002), "Modifying adoption research for mobile internet service adoption: cross-disciplinary interactions", in *Proceedings of the 36th Hawaii International Conference on System Sciences*, Big Island, HI.
17. Pousttchi, K., and Schurig, M. (2004), "Assessment of today's mobile banking applications from the view of customer requirements", *in Proceedings of the 37th Hawaii International Conference on System Sciences, IEEE*.
18. Sulaiman, A., Jaafar, N. I., and Mohezar, S. (2007), "An overview of mobile banking adoption among the urban community", *International Journal of Mobile Communications*, Vol. 5 No. 2, pp. 157-168.
19. Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. (2003). "User acceptance of information technology: toward a unified view", *Expert Systems with Applications*, Vol. 32 No. 2, pp. 336-348.
20. Zhou, T, Lu, Y, and Wang, B. (July, 2010), "Integrating TTF and UTAUT to explain mobile banking user adoption", *Computers in Human Behavior*, Vol. 26 No. 4, pp. 760-767.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

USING SUSTAINABLE COMPETITIVE ADVANTAGES TO MEASURE TECHNOLOGICAL OPPORTUNITIES

Josu Takala, Department of production/Industrial management, University of Vaasa, Vaasa, Finland, Po.box 700, FI-65101, josu.takala@uwasa.fi

Matti Muhos, Department of production/Industrial management, University of Vaasa, Vaasa, Finland, Po.box 700, FI-65101, Matti.Muhos@oulu.fi

Sara Tilabi, Department of production/Industrial management, University of Vaasa, Vaasa, Finland, Po.box 700, FI-65101, Sara.tilabi@stuent.uwasa.fi

Mehmet Serif TAS, Department of production/Industrial management, University of Vaasa, Vaasa, Finland, Po.box 700, FI-65101, mehmet.tas@student.uwasa.fi

Bingli Yan, Department of production/Industrial management, University of Vaasa, Vaasa, Finland, Po.box 700, FI-65101, skyble820101@gmail.com

ABSTRACT

Purpose: *This paper tries to find operative competitive advantage. The results of this paper help small and medium size enterprises (SMEs) which are striving to export. In fact, this paper introduces a new technique which applies critical factor analysis, risk and opportunities analysis to measure and propose resource allocation for companies in couple of next years.*
Research questions: *In this paper two questions are answered: 1. How to evaluate Knowledge and Technology (K/T) effect on operative Sustainable Competitive Advantages (SCA)?. 2. How the results from calculation Critical Factor Indexes (CFIs), SCA level and K/T are evaluated?*
Design/Methodology/approach: *This research is based on 7 case studies from Oulu South region of Finland. The cases were selected from manufacturing industry including cases focusing on manufacturing of wood product, machinery and equipment, and instruments and appliances. In this research paper, the effect of technology and knowledge on SCA risk level is investigated. In other words, here this question is answered: what would be the effect of T/K calculation on (Balanced) Critical Factor Index changes.*
Findings: *The effect of Knowledge/Technology(K/T) on (Balanced) Critical Factor Index changes depending on the proportions allocated among the different technological levels (Basic, Core or Spearhead) for each attribute separately. Therefore, the effect of K/T may be analyzed by taking the dominating technology and the resource allocation into consideration for each attribute respectively.*

Research limitations/implications: *in this research paper, 7 case studies are investigated. For 6 of them, at least 2 respondents are interviewed. However in one case, there is only one respondent. So in this case, the calculation of CFI factor is not possible. Moreover, as the number of respondents of each case is not big, so it is not possible to eliminate the effect of standard deviation in calculation of CFIs factor.*
Practical implications: *This research helps firms to take balance in resource allocation for each attribute in changing environments on the basis of different level of technology (Basic, Core or Spearhead).*

Key words: Sense and response methodology, Sustainable competitive advantage (SCA) model, Risk level, knowledge and technology (K/T), Oulu South region, Small- and medium –sized enterprise (SME).

Originality/Value: this paper presents the 'first in the world' case study on operative sustainable competitive advantage and corresponding risk levels by taking into account technology and knowledge effects for 7 SME companies.

INTRODUCTION

The world is changing every day and this unstable situation influences on business in huge scale. Among this turbulent environment, operation strategy is one of the most essential tools which can helps manages to save their position or even get more share in global market. According to Si, Takala and Liu (2010),"The future competitiveness of manufacturing operations under dynamic and complex business situations relies on forward-thinking strategies". In fact, companies should have multifocused strategy at the same time and try to consider competitive priorities consist of time, quality, cost and flexibility according to market analysis.

Sustainable competitive advantages (SCA) notion was defined by Porter 1985 for the first time and it has evolved slowly from then. In 1991, Barney completed it as: A firm is said to have a sustained competitive advantage when it is implementing a value creating strategy and when these other firms are unable to duplicate the benefits of this strategy".

Later in 2001 Barney developed his definition and introduced SCA as a resource base theory. The core concept behind resource based strategy is that if a firm is to achieve a state of SCA, it must acquire and control valuable, rare, inimitable, and nonsubstitutable resources.
Marone (1989) believes that considering technology provides some opportunity for firm in the process of decision making and setting strategy for future. So Knowledge and Technology is included in sense and respond questionnaire to calculation SCA levels.

In this paper the effect of K/T factor on SCA level is investigated. The paper tries to answer two questions: 1. How to evaluate K/T effect to operative SCA?. 2. How the results from calculation CFIs, SCA risk level and K/T are evaluated?
In order to answer the questions, seven case companies from Oulu region of Finland are investigated, from each case company; at least 2 respondents are interviewed. Only in one case company (C), one respondent is interviewed.

This paper introduces a short literature review to the topic and some background information about the case companies. In the next part, general results of including K/T factor on SCA risk level are presented. Then the results of weak market test (WMT) are presented to show how this model meets reality. In next stage, Company E which shows good condition according to WMT is investigated in detail. Finally, discussion about the question and conclusion come.

THEORY BACKGROUND

1. Manufacturing strategy:

Quinn (1980) defines strategy as "the pattern or plan that integrates an organization's major goals, policies and action sequences into a cohesive whole". A well-formulated strategy helps marshal and allocates an organization's resources into a unique and viable posture based upon its relative internal competences and shortcomings, anticipated changes in the environment, and contingent moves by intelligent opponents. From then, the concept of strategy evolved in such a way that nowadays this concept; also include a corporate social responsibility and new models of leadership (Grant, 2005).

It should be mentioned here that there is a significant different between corporate strategy and business strategy. In fact, corporate strategy means overall business portfolio, acquisitions, divestments, joint ventures and major reorganizations while business strategy defines single business or product line strategy. The following picture shows the differences between these two concepts (Daft, 1986: 476-477):

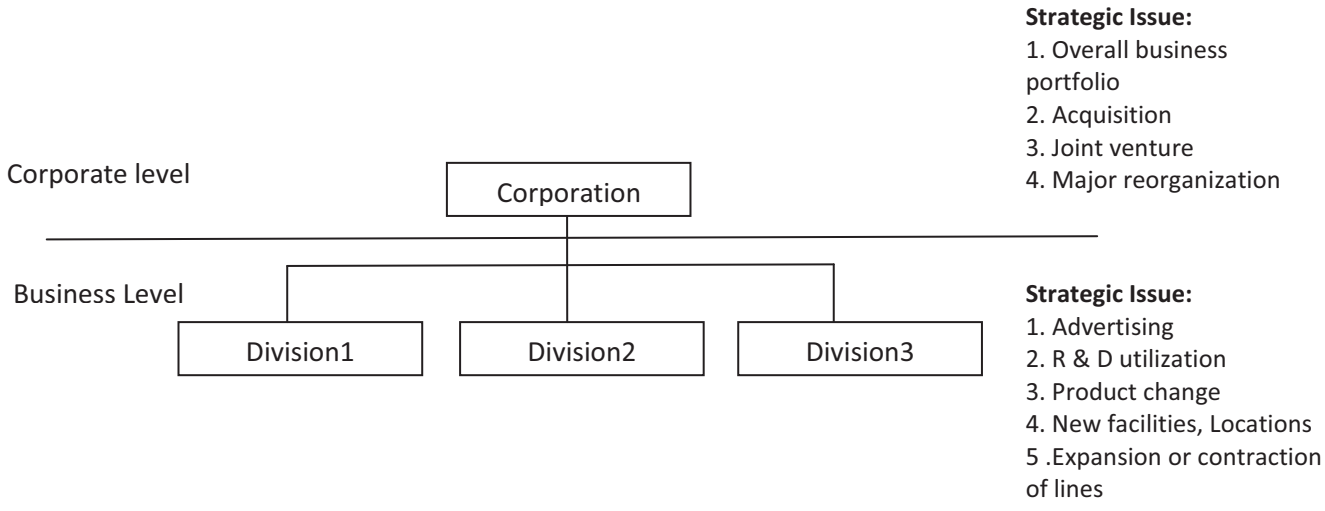


Figure1.Hierarchy of corporate and business level strategies (Daft, 1986: 477)

A long with the strategy definitions, several archetypes or topologies have been proposed to define the decisions and directions that managers implement in their organizations.
On of the most famous strategy topology is defined by Michael Porter in year 1980. In his model, he defines three generic enterprise strategies as (Porter, 1980: 34-40):

- Overall cost leader ship
- Differentiation
- Segmentation

Another famous strategy topology is defied by Miles and Snow. Miles and Snow´s competitive strategies divide the business strategies on to four groups (Daft, 2009):

- Defender: concentrates in a mature product or market operation. This strategy focus on efficiently and prefer not to take risk . in this type of strategy company tries to strengthen efficiency and maintain their current costumers.
- Prospector strategy: looks forward to new opportunities in market. This strategy is dynamic and tries to innovate in processes and take risk. Besides, this type of strategy focus to lead it's industry.
- Analyzer strategy: is placed between the defender and prospector strategy and tries to conserve a steady state in market.
- Reactor strategy: is no-strategy and happens in absence of defined goals and objectives. In this type of strategy, decisions are taken to respond immediate problems as there is no sense of direction.

According to Daft (1986: 480) the choice between these alternatives depends on the current product life cycle and how does the management interpret the external environment. There are three main problems, which drives the companies to make decisions among these possibilities: Entrepreneurial, engineering, and administrative problems (Daft 1986: 481). Differences between these different company types are listed in the table below:

Table 1.Strategy types: (Daft 1986: 481, Miles, Snow, Meyer & Coleman Jr., 1978: 557-558).

Characteristic	**Defender**	**Analyzer**	**Prospector**	**Reactor**
Environment	Stable	Moderately Changing	Dynamic, Growing	Any condition
Strategy	Seal Off share of market Protect tuff. Advertise to hold customer	Maintain market but innovative at edges. Locate opportunities for expansion while protecting current position	Find and exploit new market opportunities. Scan environments. Take risk.	Not clear strategy . React to specific condition. Drift.
Internal characteristic	Efficient production. Retrench	Efficient production yet flexibility for	Flexible production. Innovation and	Now clear organization approach.

Characteristic	Defender	Analyzer	Prospector	Reactor
	tough control. Centralized mechanistic	new lines. Tight control over current activities. Looser for new lines.	coordination. Expansion. Centralized organic.	Depends on current needs.

Madu el al (1996) introduced a technology path for different technology level. This model is completed by Takala later. The idea behind this model is that when a company starts to sell its product. It moves from Technology specialist to commodity product, collaboration partner and problem solver step by step. This concept shows in following picture (Takala, Hirvela¨ and Liu):

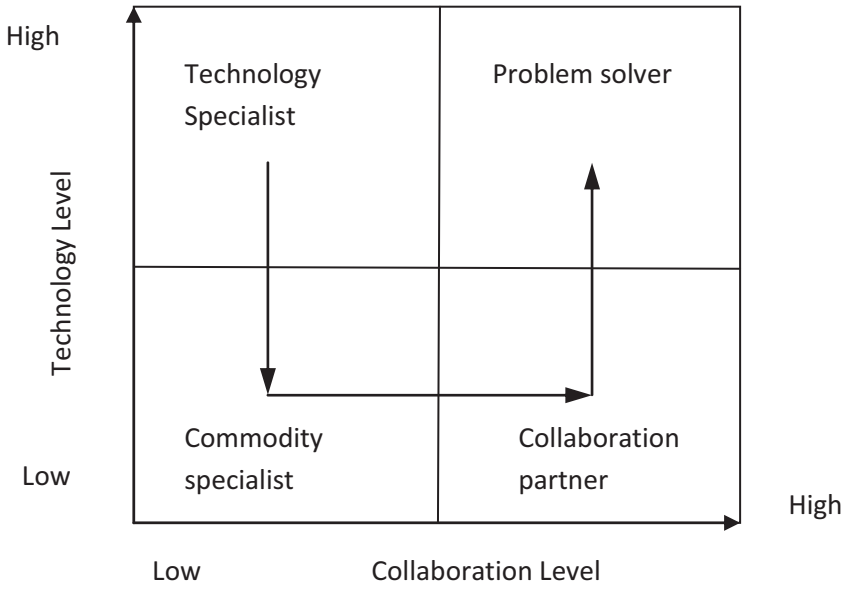


Figure2.Technology path: modified from et al. (1996)

A manufacturing strategy based on a business strategy includes three objectives: competitive priorities, manufacturing objectives and action plans. In other words, first competitive priorities for a company are defined. Then, regarding to competitive priority manufacturing strategy are defined. Finally in last step, suitable action plan to achieve strategic goal is defined and implemented. The following picture shows this process model (Kim and Arnold. 1996):

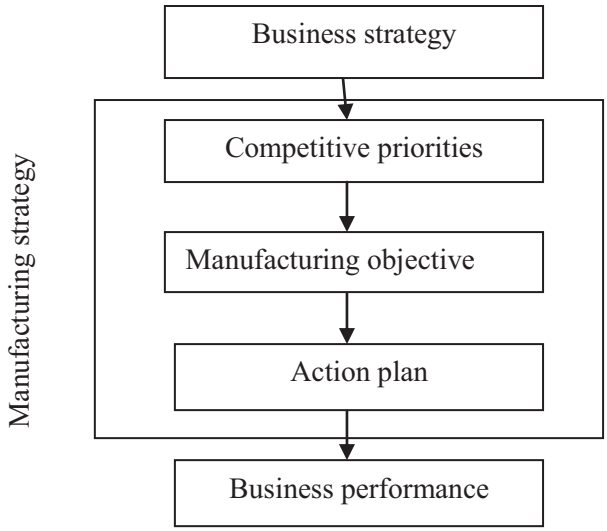


Figure3.Process model of manufacturing strategy, Kim and Arnold(1996)

2. Resources based view of the firm:

Barney et al(2001), suggest sustainable competitive advantages as a resource- based strategy. The core concept behind resource based strategy is that if a firm is to achieve a state of SCA, it must acquire and control valuable, rare, inimitable, and nonsubstitutable resources. Moreover, this firm should have an organization can absorb and apply them (Jeroen Kraaijenbrink, J.-C. Spender and Aard J. Groen,2010). It should be emphasized here that technology as know-how, is a relevant part of resource based strategy (Braun, 1998; Takala, 1997).

Wernerfelt (1984), suggests that analyzing a firm from the resource side has more benefit rather than from the product side.In fact, he believes that the resources and the product should be taken to account at the same time and finding optimal product market activities is possible by specifying a resource profile for a firm.

METHODS

1. AHP, questionnaires, data collection and analysis

According to Saaty 1980,"The Analytic Hierarchy Process (AHP) method is a multi-attribute decision instrument that allows considering quantitative, qualitative measures and making tradeoffs"(Yang Liu and Josu Takala).

The data of case company are collected by asking managers or people from managements group to answer the questionnaires from different departments. The interviewees are normally decision makers and middle management groups in the case company, who understand the operations of the company, and the number of informants is dependent on the size of the case company. The interviewed high competence experts should be representative to know well the operations of the studied case company.

2. CFIs, Sense and respond

The sense & respond model is used to help in dynamic decision-making to describe, evaluate, benchmark and optimize lower level resource allocations to meet the performance requirements in all the interest groups inside and outside the organization and in turn to improve higher level strategies. The critical factor index (CFI) method is a measurement tool to indicate which attribute of a process is critical and which is not, based on the experience and expectations of the interviewees. The S&R model has gone through three stages of development, which are called CFI model, BCFI model, and SCFI model.

3. Manufacturing strategy

The analytical models for manufacturing strategy are used to calculate the operational competitiveness indexes of companies in different competitive groups, namely prospector, analyzer and defender. The manufacturing strategy index (MSI) is modeled based on the multi criteria priority weights of Q (Quality), C (Cost), T (Time/delivery) and F (Flexibility), as function $MSI = f_{MSI}(Q, C, T, F)$.

Figure 5 shows different position of a firm considering operation strategy. In this picture, prospectors are constantly seeking for new market and product innovations. They create instability in the market. Prospectors are concentrating in quality so they are not as cost-effective as defenders. Analyzers work both static and dynamic markets. In static markets they seek to operate as cost-effective as possible and in dynamic markets they are observing their competitors and try to adapt most promising ideas. Defenders work at narrow market areas and they have narrow product portfolio. Defenders are concentrated to intensify their existing processes and they don't seek new product and market innovations.

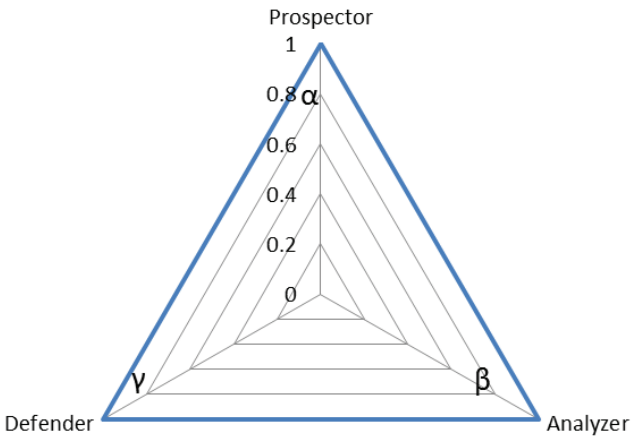


Figure4: Manufacturing strategy

4. SCA, MAPE, RMSE, MAD

Sustainable competitive advantage (SCA) is the measurement of risk level for that the operation strategy should be improved to sustain the operation competitiveness during the period considered. There are three indexes, which are MAPE, RMSE and MAD, to measure the risk level of the operation strategy for sustainable competitive advantages in this paper.

5. Technology Rankings, BCFI K/T

Knowledge/Technology requirement section has been added to the Sense and Response questionnaire to gather information about the companies' knowledge/technology rankings. Basic technology is referring to technologies commonly used and that can be purchased or outsourced, Core technology is referring to company's current competitive technologies and Spearhead technology is referring to the technologies focused on the future. Each attribute in the list is numbered and analyzed in graphs with respect to the order. The importance of different technological levels (Basic, Core or Spearhead), in technology-based businesses, affects a lot the strategy implementation by the knowledge required, and supports the company's success in the competitive category chosen. The attributes are assigned to one of the multiple key categories of RAL model Quality (Q), Cost (C), Time/Delivery (T) and Flexibility (F), depending on their most significant effect.

CASE INTRODUCTION

Oulu South region:

Oulu South Area is located in Northern Ostrobothnia in the southern part of the province of Oulu. It has three sub-region area of cooperation. The area includes a total of 14 municipalities with a total population of just under 90 000, or about a quarter of the Northern Ostrobothnia population. In 2001, Oulu Southern Regional Ministry of the Interior approved the regional center program three sub-region network-type cooperation area. The region's development strategy has been prepared in Oulu South 2015 agreement. The contract shall be entered in the main area of development in 2007-2015.

Oulu South is one of the main agricultural areas - the area can be characterized as an industrialized in rural areas, because the region offers a significant extent, the manufacturing industry jobs. The largest industries are agriculture, metals, wood products industry, and information and communication technology (ICT). The regional unemployment rate is among the lowest in northern Finland and the age structure of the population is young. This differentiates from other Finnish Oulu Southern rural areas. Oulu South is a business-friendly area where currently about 4,600 active companies. Of these, about 95% of companies are micro-enterprises.

RESULTS

1. The result of including K/T factor on SCA risk Level

The following tables shows how calculating K/T factor effect on SCA risk level:

1.1 SCA risk level in past without K/T:

Table 2.SCA risk level for Oulu South region (Past)

Past	A			
	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.95	0.88	0.87	
RMSE	0.96	0.92	0.92	
MAD	0.97	0.94	0.94	

Past	B			
	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.95	0.88	0.87	
RMSE	0.96	0.92	0.92	
MAD	0.97	0.94	0.94	

Past	C			
	CFI	BCFI	SCFI	BCFI T/K
MAPE		0.94	0.92	
RMSE		0.96	0.95	
MAD		0.97	0.96	

Past	D			
	CFI	BCFI	SCFI	BCFI T/K
MAPE	1.00	0.95	0.91	
RMSE	1.00	0.97	0.94	
MAD	1.00	0.97	0.95	

Past	E			
	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.90	0.87	0.90	
RMSE	0.94	0.92	0.94	
MAD	0.95	0.93	0.95	

Past	F			
	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.98	0.91	0.92	
RMSE	0.99	0.94	0.95	
MAD	0.99	0.95	0.96	

Past	G			
	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.90	0.88	0.89	
RMSE	0.94	0.92	0.92	
MAD	0.95	0.94	0.94	

According to the above table, almost all the risk levels are less than 0.10 which means that the company operation strategy is sustainable. Only in three cases (one from case A, one from Case B and two from Case G) risk level is a little more than 0.10 which is not significant considering all the good results.

1.2. SCA risk level in future considering K/T

The following tables show the effect of K/T calculation on SCA risk level in future:

Table 3.SCA risk level for Oulu south region considering K/T (Future)

Future	A			
	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.88	0.98	0.98	0.80
RMSE	0.93	0.99	0.99	0.88
MAD	0.94	0.99	0.99	0.90

Future	B			
	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.88	0.98	0.98	0.80
RMSE	0.93	0.99	0.99	0.88
MAD	0.94	0.99	0.99	0.90

Future	C			
	CFI	BCFI	SCFI	BCFI T/K
MAPE		0.94	0.93	0.94
RMSE		0.96	0.95	0.96
MAD		0.97	0.96	0.97

Future	D			
	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.96	0.91	0.95	0.90
RMSE	0.97	0.95	0.97	0.94
MAD	0.98	0.96	0.97	0.95

Future	E			
	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.88	0.88	0.84	0.83
RMSE	0.93	0.93	0.90	0.90
MAD	0.94	0.94	0.92	0.92

Future	F			
	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.83	0.97	0.97	0.94
RMSE	0.90	0.98	0.98	0.96
MAD	0.91	0.98	0.99	0.97

Future	G			
	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.76	0.79	0.79	0.81
RMSE	0.85	0.87	0.87	0.88
MAD	0.89	0.90	0.90	0.91

According to all the tables above, calculating K/T affects the risk levels. Means that considering K/T factor dose not reduce SCA risk level. In more details, in four cases company contain A, B, D and F the SCA risk level increased after adding K/T factors. In C and G Company the risk level decreased but it is not significant and In case E, SCA risk level stays almost unchanged after adding K/T factor.

1.3. Weak Market Test (WMT):

In order to understand how the calculated results meet the reality the weak market test (WMT) is conducted by interview managers from each company. This new interview is conducted by phone or face to face meeting.

Table4. The results of WMT

	Company Name:	Main Activity/ Industry	Informants	Interview by: phone/Meeting	WMT results with all the results of MSI, DEA, S&R, SCA
1	G	Automation for Mechanical wood industry Civil engineering	Managers	Phone	As expected, OP management too dependent on Manager. Justifies their pre - understanding in a useful manner
2	C	Sawmill	Manager and two persons from management group	Meeting	As expected, very exact result and something new. Verifies the roots of decision making capabilities.
3	F	Mechanical wood products	Manager	Meeting	Accepted
4	E	Manufacturing of sports goods	Manager	Phone	Extremely good, fit of the findings within Operations strategy and sustainable competitive advantage
5	B	Electronics and software	Manager	Meeting	No contradiction with the situation in the operative level Uncertainty and Challenge with the General strategy and ownership

Unfourtuanly, we could not interview the managers from A and D company in this step so the results of WMT is not available.

2. The results of CFIs and T/K calculation for Company E in detail:

In following parts, the results of company E which shows a good condition according to weak market test is explained in detail:

2.1. Expectation VS Experience:

It demonstrates the comparison between the experiences and expectations of the respondents in Figure 5. According to this figure, the average of expectation is more than the average of experience and it means that the company plans to improve the level of different criteria for future.

Figure 5: Detection of the attributes for future competitiveness

2.2. Critical Factor Index (CFIs), Operation Priorities

There are three different colors defined for the resource allocation of the attributes: red, yellow and green, which represent whether an attribute is under resourced, over resourced or balanced. Here the resource allocation of the attributes is considered to be ideal if it is equally distributed. The whole resource is counted to be 100% and it is divided to the total number of attributes. By this division the average resource level is defined. An attribute is counted to be balanced and takes the green color if CFIs value is between the range of 1/3 and 2/3 of average resource level. For the rest, any attribute which has a lower CFIs value than 1/3 of average resource level is counted to be under resourced and takes the red color, and any attribute which has higher CFIs value than 2/3 of average resource level is counted to be over resourced and takes the yellow color (Liu et al, 2012).

Figure 6, shows critical factor index in terms of CFI for future. According to this bar chart, only four attributes are balance resource (the black ones) and sixteen attributes are critical resource (over resources or under resources) in CFI (OP) figure.

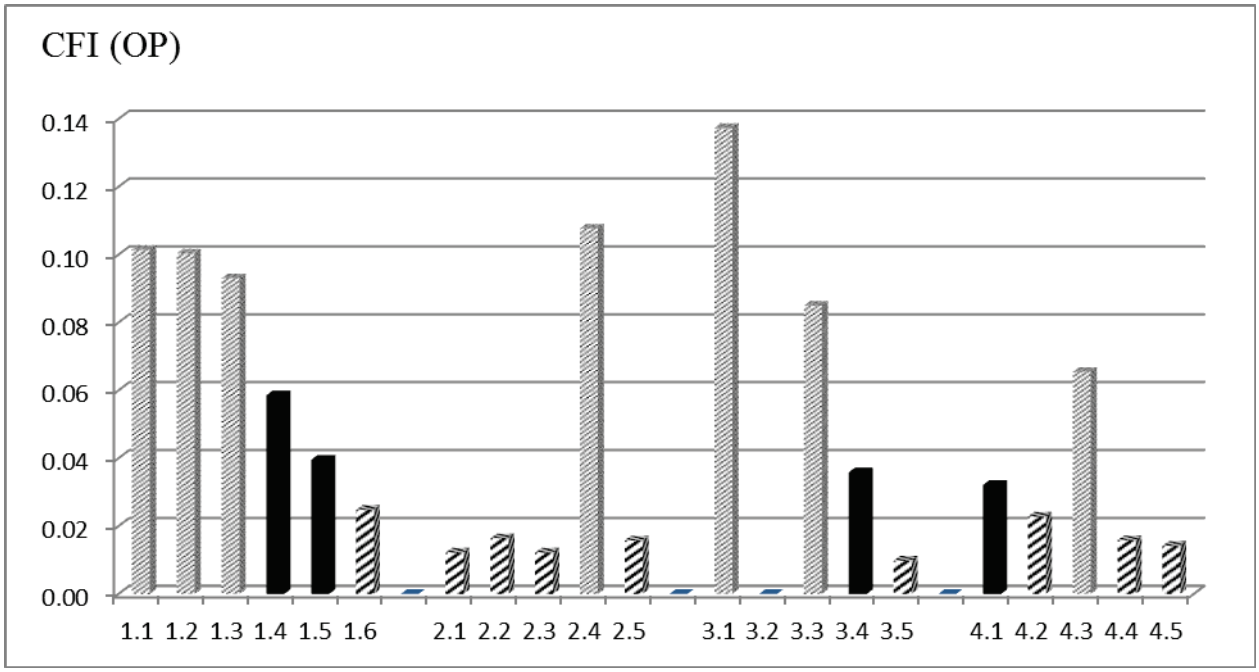


Figure 6: Critical Factors (Operations Priorities)

Next figure shows critical attribute in terms of BCFI. Bar chart shows that three attributes are over (bars with lighter color) and four attributes are under resource (bars with stranger color) in BCFI (OP) figure.

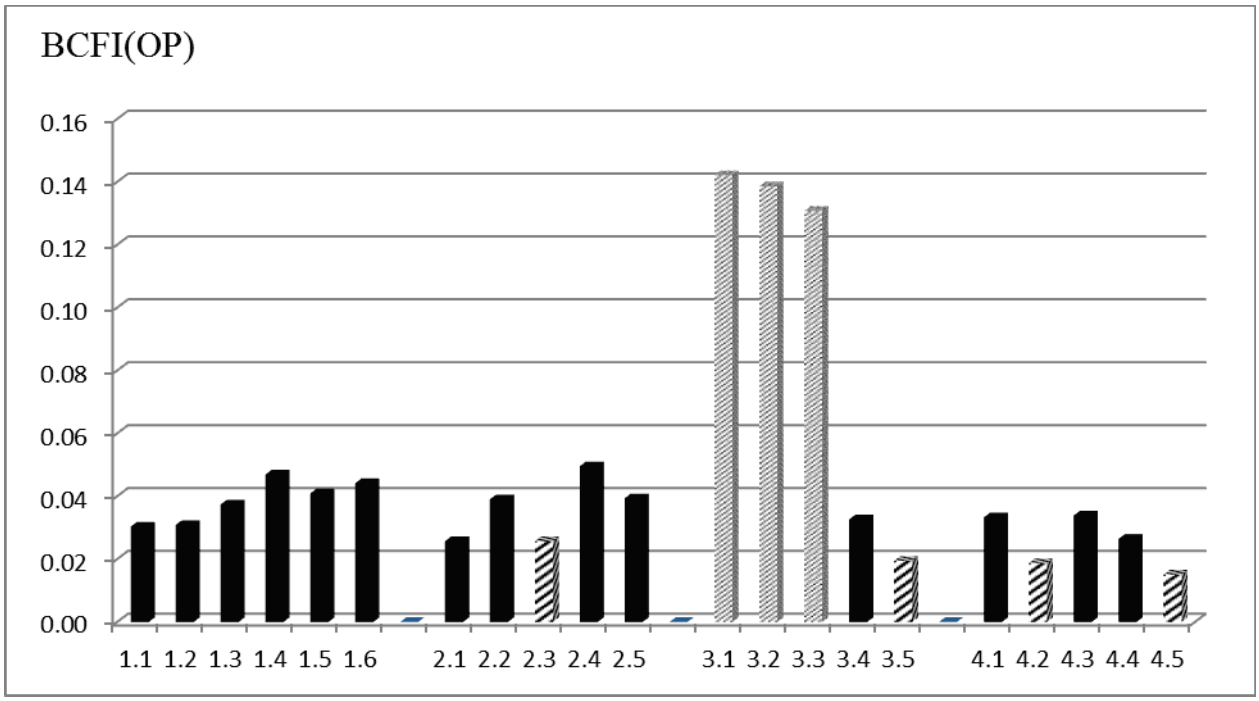
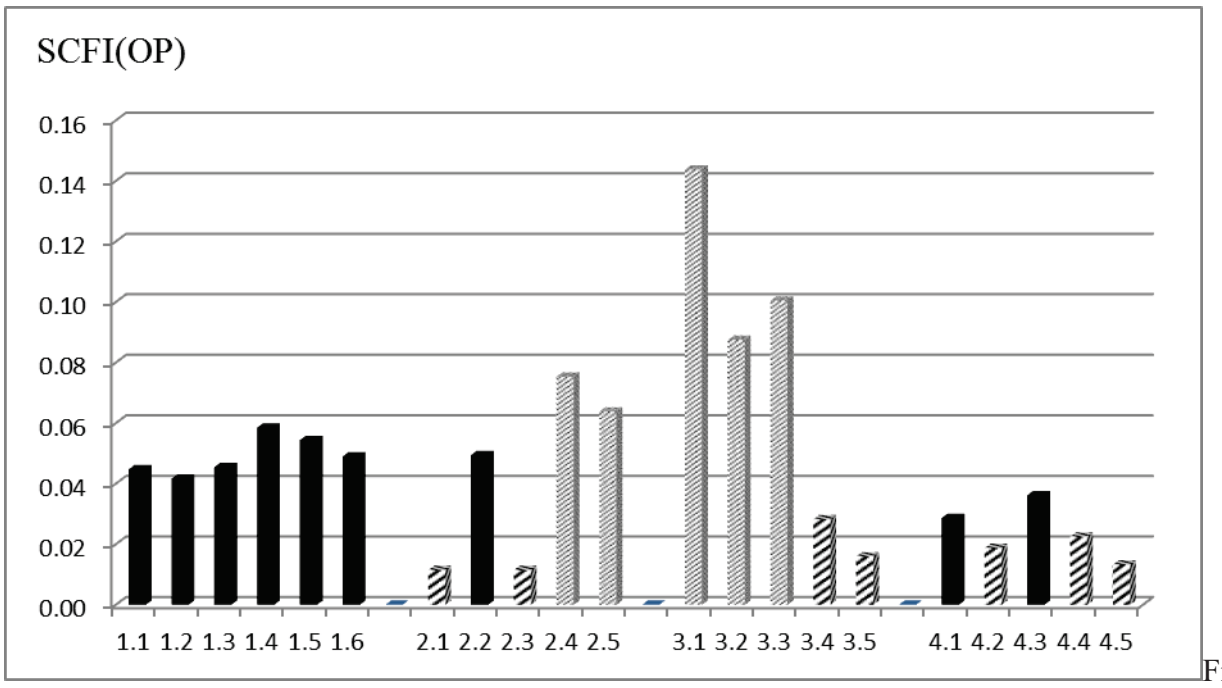


Figure 7. Balanced Critical Factors (Operations Priorities)

Figure 8, shows critical attribute in terms of SCFI calculation. It shows that five attributes are over and seven attributes are under resource in SCFI (OP) figure.



Fig

Figure 8. Scaled Critical Factors (Operations Priorities)

2.3. SCA calculation

In table 5, the PAD (prospector, Analyzer, Defender) values for both past and future competitive strategy are calculated based on CFI. In past strategy, the PAD value for prospector is 0.89, for analyzer is 0.93 and for defender is 0.92. In future strategy, the PAD value for prospector is 0.89, for analyzer is 0.94 and for defender is 0.91.

Tabale5.SCA value (CFI)

	prospector	Analyzer	Defender
Past	0.89	0.93	0.92
Future	0.89	0.94	0.91

In table 6, PAD values for both past and future competitive strategy are shown based on BCFI. In past strategy, the PAD value for prospector is 0.90, for analyzer is 0.96 and for defender is 0.92. In future strategy, the PAD value for prospector is 0.91, for analyzer is 0.95 and the angle for defender is 0.91.

Table6. SCA values (BCFI)

	prospector	Analyzer	Defender
Past	0.90	0.96	0.92
Future	0.91	0.95	0.91

In table 7, PAD values for both past and future competitive strategy are shown on the basis of SCFI. In past strategy, PAD value for prospector is 0.89, for analyzer is 0.94 and for defender is 0.92. In future strategy, the PAD value for prospector is 0.90, for analyzer is 0.98 and for defender is 0.91.

Table7. SCA values (SCFI)

	prospector	Analyzer	Defender
Past	0.89	0.94	0.92
Future	0.90	0.98	0.91

In Table 8, the SCA risk level (for past and without the effect of K/T) is measured by the MAPE, RMSE and MAD based on the CFI, BCFI and SCFI.

Table 8: SCA Risk Level (past)

	CFI	BCFI	SCFI
MAPE	0,90	0,87	0,90
RMSE	0,94	0,92	0,94
MAD	0,95	0,93	0,95

In Table 9, the SCA risk level (for future and including the effect of K/T) is measured by the MAPE, RMSE and MAD based on the CFI, BCFI and SCFI.

Table 9: SCA Risk Level (Future)

	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.88	0.88	0.84	0.83
RMSE	0.93	0.93	0.90	0.90
MAD	0.94	0.94	0.92	0.92

2.3. Knowledge and Technology (K/T) effect:

In general the company's current competitive technologies (Core Technology) seem to be around 40%, the technologies commonly used (Basic Technology) are around 40% and the technologies focused on the future (Spearhead Technology) are around 20% for most of the attributes (Figure 10). From technology rankings point of view the company is found to be competitive one and aims to follow a positive slope in case of technology as it is aiming to improve it in future case.

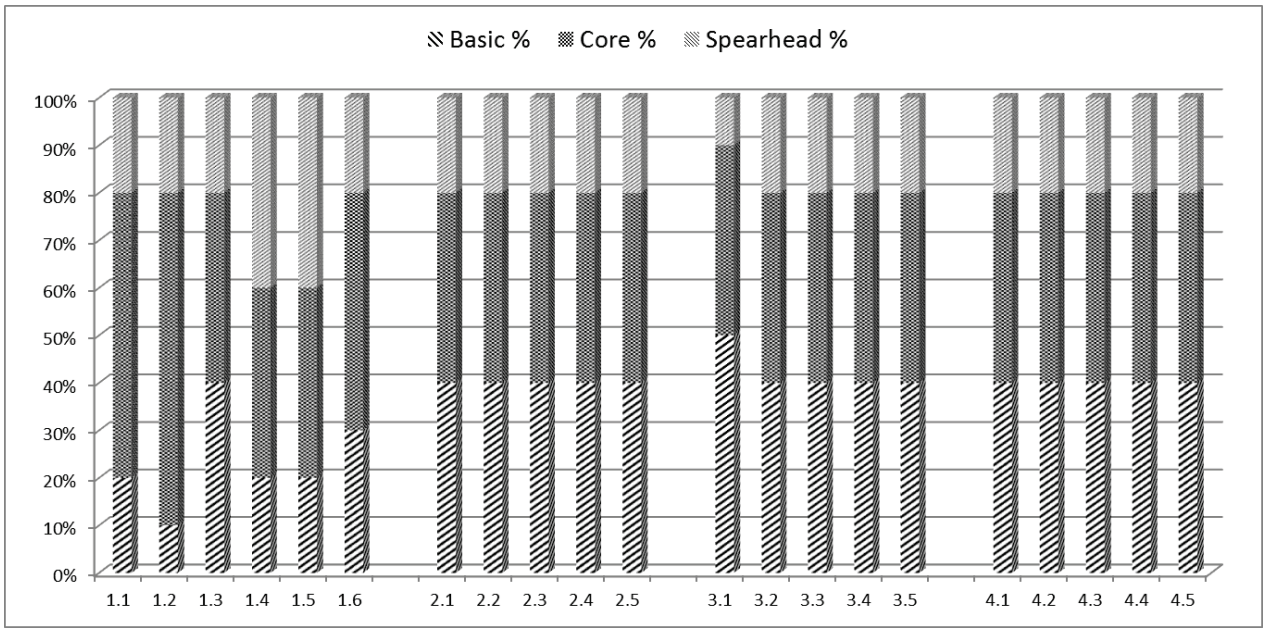


Figure 9: Technology and Knowledge

In Figure 10, the red bars represent the knowledge/technology based BCFI values and other bars stand for traditional BCFI values. From the technology point of view, the attributes number 2.2, 2.4, 2.5, 3.1, 3.2, 3.3, 3.4 seen to be over resourced in terms of BCFI TK, these attributes are observed to be less critical compared to BFCI values, for some attributes are more critical.

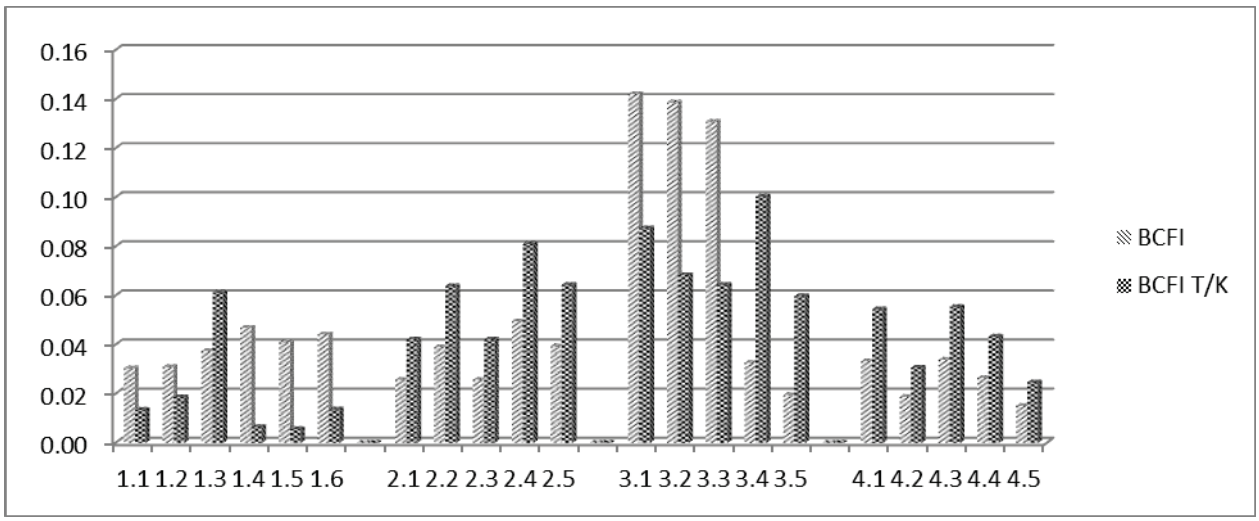


Figure10: BCFI and BCFI T/K

DISCUSSION

In this paper seven case companies from Oulu South region of Finland are investigated to answer two questions:

First question seeks to find the effect of K/T factor on SCA risk level. Investigation these seven case companies' shows that including K/T factor dose not decrease the SCA risk level in general. In fact, including K/T calculation enhances the risk level only in case C and G just a bit. But this amount of enhancement is not significant. In only one case (E) SCA risk level stays almost unchanged after adding K/T factor and for the rest of cases consist of A,B, D and F risk level increased after adding K/T factors .

Second question focus on evaluation of CFIs calculation, SCA level and K/T factor. To answer this question one case company (E) which shows good condition according to WMT (and results of calculation meet the reality well), is investigated in detail. The following results are obtained: first: investigation of case E shows that including K/T in BCFI calculation, does not guide attribute to more or less critical places in general. In other words, for some attribute BCFI K/T shows more critical position compared to BCFI and for some of them BCFI K/T shows less critical position compared to BCFI(no specific direction). Second: the strategy of case E is sustainable. In other words, there is not any significant difference between the result of SCA level in past and future and all of the SCA levels show the position of Analyzer for company E in past and future. This result can be very useful for managers and shows them if in future the company wants to get the position of prospector and lead the market they need and should to invest on the resources which are related to quality otherwise in best condition they can only save this current position for future.

CONCLUSION

The study of sustainable competitive advantage is essential – it uses the Sensing and Responding methodology to finding critical factors in experiences and expectations. The study presents methodology which evaluates the effect of K/T to SCA risk level by taking resource allocation to consideration. Moreover this methodology ensures that the various resources of the organization are operating in accordance with common strategy. The value of the methodology is in its ability to make the structure of the organizations and strategies transparent for developing actions. General finding of the development work is an importance of information technology for the target organization and transformational leadership for proactive preparedness.

In summary, the results of weak market test for 5 companies show that in general, this model is applicable in real business world and the outcomes are not far away from mangers exception but in order to validate and test formula for strategic decision making process, more studies and investigation is necessary and this model is still in initial stages.

REFERENCES

1. Barney, J.B., Wright, M. and Ketchen, D.J. Jr (2001). "The resource-based view of the firm: ten
2. years after 1991". Journal of Management, Vol. 27, pp. 625-41
3. Barney, Jay B;Zajac, Edward J(1994), "competitive organizational behavior towards an organizational based theory of competitive advantages". strategic managements Journal, Vol. 15, 5-9
4. Braun, E. (1998). "Technology in Context. Technology Assessment for Managers". The Management of Technology and Innovation, Routledge, London.
5. Bradley, Stephen P. & Richard L. Nolan (1998). "Sense and Respond Capturing Value in the Network Era". Boston, Massachusetts: Harvard Business School Press. 4-26 p. ISBN 0-87584-835-4
6. Daft, Richard L. (1986). "Organization theory and design". 2. ed. St. Paul: West publishing Co. 571p. ISBN0-314-93170-8
7. Daft, R. L. "Organization Theory and Design". Masson: Cengage Learning,2009.
8. Jeroen Kraaijenbrink, J.-C. Spender and Aard J. Groen(2010). "The Resource-Based View: A Review and Assessment of Its Critiques,Journal of management". 2010; 36; 349
9. Grant, R. M(2005). "Contemporary strategy analysis". Malden: Blackwell Publishing.
10. Porter, Michael E. (1980). "Competitive Strategy: techniques for analyzing industries and competitors". New York: Free Press, corp. 397p. ISBN 0-02-925360-8
11. Madu, C.N., Aheto, J., Kuei, C. and Winokur, D. (1996). "Adoption of strategic total quality management philosophies: multi-criteria decision analysis model". International Journal of Quality & Reliability Management, Vol. 13 No. 3, pp. 57-72.
12. Miller Danny (1996). "the resource based view of the firm in two environments: the Hollywood film studio from 1936 to 1965". Academy of Management Journal, 1996, Vol. 39, No. 3. 519-543.
13. Miles, Raymond E., Snow, Charles C., Meyer, Alan D. & Coleman, Henry J. Jr. (1978). "Organizational Strategy, structure, and process". The academy of management review, Volume 3, Issue 3, 546-562p.
14. Si, Tkala and Liu (2010). **"**Benchmarking and developing the operational competitiveness of Chinese state-owned manufacturing enterprises in a global context, Int". J. Innovation and Learning, Vol. 7, No. 2, 2010
15. Takala, Hirvela¨ and Liu(2007)."Global manufacturing strategies require "dynamic engineers"? Case study in Finnish industries". Industrial Management & Data Systems Vol. 107 No. 3, 2007 pp. 326-344
16. Quinn, J. B. Strategies for Change(1980.). "Logical Incrementalism". Homewood: McGraw-Hill Higher Education,
17. Wernerfelt, B. (1984). "A resource-based view of the firm". Strategic Management Journal, 5: 171-180.
18. Yang Liu and Josu Takala. "Proactive Crisis Management in Global Manufacturing Operations, Department of Production". University of Vaasa PL 700, 65101 Vaasa Finland

APPENDIX

1.The models of CFI, BCFI and SCFI

Name	Model
CFI	$CFI = \frac{Std\{\exp erience\} \times Std\{\exp ectation\}}{\mathrm{Im}\, por\tan ce\ index \times Gap\ index \times Development\ index}$ (1)
BCFI	$BCFI = \frac{SD\{\exp erience\} \times SD\{\exp ectation\} \times Performance\ index}{\mathrm{Im}\, por\tan ce\ index \times Gap\ index \times Development\ index}$ (2)
SCFI	$SCFI = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}[\exp erience(i)-1]^2} \times \sqrt{\frac{1}{n}\sum_{i=1}^{n}[\exp ectation(i)-1]^2} \times Performance\ index}{\mathrm{Im}\, por\tan ce\ index \times Gap\ index \times Development\ index}$ (3)

Parameters:

$$\mathrm{Im}\, por\tan ce\ index = \frac{Average(\exp ectation)}{10};$$

$$Gap\ index = \left|\frac{Average(\exp erience) - Average(\exp ectation)}{10}\right|;$$

$$Development\ index = |0.9 \times (better - worse) - 1|;$$

$$Performance\ index = \frac{Average(\exp erience)}{10};$$

$$SD(\exp erience) = \frac{Std(\exp erience)}{10} + 1;$$

$$SD(\exp ectation) = \frac{Std(\exp ectation)}{10} + 1.$$

2. Calculation of MSI factors:

The equations to calculate normalized weights of core factors are as follows:

$$Q' = \frac{Q}{Q+C+T} \quad (4)$$

$$C' = \frac{C}{Q+C+T} \quad (5)$$

$$T' = \frac{T}{Q+C+T} \quad (6)$$

$$F' = \frac{F}{Q+C+T+F} \quad (7)$$

$$Q = Quality; C = Cost; T = Time/delivery; F = Flexibility.$$

3.The analytical models to calculate the manufacturing strategy indexes of operational competitiveness in each group :

The MSI model for prospector group:

$$MSI_p = 1-(1-Q^{'1/3})(1-0.9T^{'})(1-0.9C^{'})F^{'1/3} \quad (8)$$

The MSI model for analyzer group:

$$MSI_A = 1-(1-F^{'})\left|(0.95Q^{'}-0.285)(0.95T^{'}-0.285)(0.95C^{'}-0.285)\right|^{1/3} \quad (9)$$

The MSI model for defender group:

$$MSI_D = 1-(1-C^{'1/3})(1-0.9T^{'})(1-0.9Q^{'})F^{'1/3} \quad (10)$$

4. Calculation of risk level: Models of MAPE, RMSE and MAD

The equations to calculate risk level are as follows:

Name	Models
MAPE	$MAPE = 1-\sum_{i=1}^{n}\left\|(BS_i - BR_i)/BS_i\right\|$ (15)
RMSE	$RMSE = 1-\sqrt{\sum_{i=1}^{n}[(BS_i - BR_i)/BS_i]^2}$ (16)
MAD	$MAD = 1-\max\left((BS_i - BR_i)/BR_i\right)$ (17)

5. Knowledge and Technology Calculation

$$IMPL\ Basic = \frac{std\ \{Basic\ Technology(\%)\}}{avg\ \{Basic\ technology(\%)\}} \quad (18)$$

$$IMPL\ Core = \frac{std\ \{Core\ Technology(\%)\}}{avg\ \{Core\ technology(\%)\}} \quad (19)$$

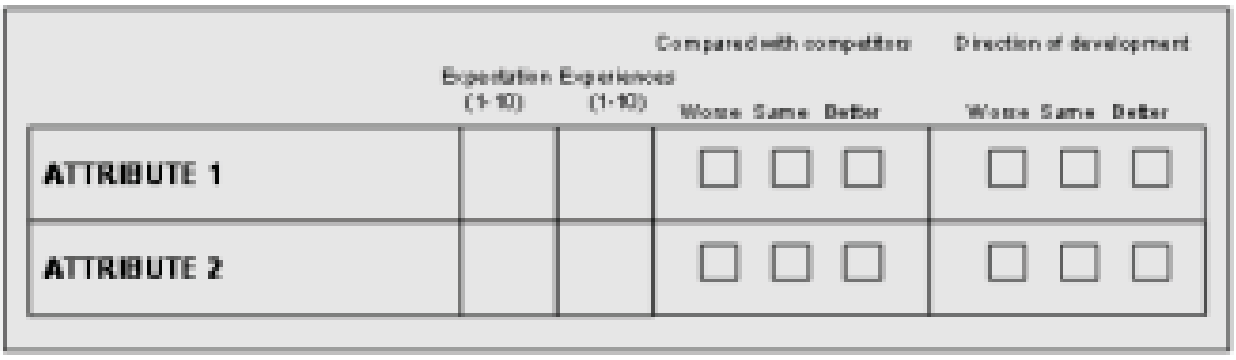
$$IMPL\ Spearhead = \frac{std\ \{Spearhead\ Technology(\%)\}}{avg\ \{Spearhead\ technology(\%)\}} \quad (20)$$

$$Technology\ IMPL = \sqrt{\sum(IMPL\ Basic^2 + IMPL\ Core^2 + IMPL\ Spearhead^2)} \quad (21)$$

6. The Criteria used in Questionnaire for Sense and respond method:

	ATTRIBUTES	
	Knowledge & Technology Management	
1.1	Training and development of the company's personnel	← Flexibility
1.2	Innovativeness and performance of research and development	← Cost
1.3	Communication between different departments and hierarchy levels	← Time
1.4	Adaptation to knowledge and technology	← Flexibility
1.5	Knowledge and technology diffusion	← Cost
1.6	Design and planning of the processes and products	← Time
	Processes & Work flows	
2.1	Short and prompt lead-times in order-fulfillment process	← Flexibility
2.2	Reduction of unprofitable time in processes	← Cost
2.3	On-time deliveries to customer	← Quality
2.4	Control and optimization of all types of inventories	← Quality
2.5	Adaptiveness of changes in demands and in order backlog	← Flexibility
	Organizational systems	
3.1	Leadership and management systems of the company	← Cost
3.2	Quality control of products, processes and operations	← Quality
3.3	Well defined responsibilities and tasks for each operation	← Flexibility
3.4	Utilizing different types of organizing systems	← Flexibility
3.5	Code of conduct and security of data and information	← Cost
	Information systems	
4.1	Information systems support the business processes	← Time
4.2	Visibility of information in information systems	← Time
4.3	Availability of information in information systems	← Time
4.4	Quality & reliability of information in information systems	← Quality
4.5	Usability and functionality of information systems	← Quality

7. Model of questionnaire for Sense and Respond method (Takala, Ranta, 2007) :



Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE RELATIONSHIPS AMONG STOCKS, BONDS AND GOLD: SAFE HAVEN, HEDGE OR NEITHER?

Shu-Mei Chiang[1]
Department of Finance, Lunghwa University of Science and Technology, Taiwan
Email: shumei@mail.lhu.edu.tw

Chi-Tai Lin[2]
Marketing & Service Division at ITRI South Campus in Industrial Technology Research Institute
Email: itri450235@itri.org.tw

Chien-Ming Huang[3]
Department of Banking and Finance, Tamkang University, Taiwan
Email: snapshop68@yahoo.com.tw

ABSTRACT

This paper applies a multivariate GARCH model to analyze the interdependence among gold, stocks and bonds price. Besides, we also examine the relationship between gold and oil price to see if gold could store value during financial crisis term. The empirical results show that gold is a feedback hedge for stocks for the full sample period. Hence, gold is a good diversification instrument for stock investment. About the correlation between gold and oil price, this paper finds that gold possesses store-value function. During the financial crisis period, gold is a safe haven for bonds only when the innovations flow from gold to bond market. On the relationship between oil price and gold, it is found that gold is no longer a fine product to resist inflation. Although the direction and duration are not identical, the impulse responses among gold, stock and bond markets are short-lived. Briefly, there exists some kind of relatedness between gold and stocks and gold and bonds. Generally, gold is a suitable tool to hedge against the stock market; whilst during financial crisis span, gold is not a safe haven for stocks.

---

[1] Shu-Mei Chiang (corresponding author) is a professor at the Department of Finance, Lunghwa University of Science and Technology, Taiwan. Address for correspondence: No. 300 Wanshou Road, Section 1, Gueishan Shiang, Taoyuan County 333, Taiwan. Tel: +886-2-82093211 ext. 6414; Fax: +886-2-82093211 ext. 6408; E-mail: shumei@mail.lhu.edu.tw.
[2] Chi-Tai Lin is a Ph. D. and is in charge of the Marketing & Service Division at ITRI South Campus in Industrial Technology Research Institute. E-mail: itri450235@itri.org.tw.
[3] Chien-Ming Huang is an Assistant Professor at the Department of Banking and Finance, Tamkang University, Taiwan. E-mail: snapshop68@yahoo.com.tw.

Keywords: Gold; Stock; Bond; Multivariate GARCH model.

INTRODUCTION

Owing to the rising oil prices and weak dollar, the quotation of gold rises steadily. In addition to gold's ability to oppose to inflation, the increasing demand for gold from emerging market, the function of gold to serve as reserves in monetary issue and the hedging necessity in the financial market also promote the price of gold. Furthermore, the particular qualities of gold make it different from other commodity, such as gold can be stored eternally and it has negligible impacts from weather changes (Lin, Chiang and Chen, 2008). Accordingly, gold possesses an unquestionable position all the time, no matter in the period of gold standard or in modern times in which gold could be a good store or protection of value along with counter-cyclical investment vehicle under political and economic uncertainty.

Charles de Gaulle has ever said, "There can be no other criterion, no other standard than gold. Gold has no nationality and is externally and universally accepted as the unalterable fiduciary value par excellence". As a consequence, gold has long been a hedge instrument against price fluctuation in other financial products. Especially for some investors, the investment in gold is regarded as a good hedge or safe haven in opposition to the movements in stock or bond markets. However, if the interrelations among stock, bond and gold change, the response to information may not be the same as before. That is, the hedging or safe haven role played by gold might disappear. Therefore, understanding the nature of the interdependence among different classes of assets, such as stock, bond and gold, is important for investors' portfolio choices.

Despite there have been many existing literature associated with gold, they are mainly tended to concentrate on the macroeconomic influences on gold market (Christie-David, Chaudhry and Koch, 2000; Cai, Cheung and Wong, 2001; Tully and Lucey, 2007), the causality relationships between gold and stock market (Smith, 2001; Mishra, Das and Mishra, 2010), the determinants of gold price (Levin and Wright, 2006; Elfakhani, Baalbaki and Rizk, 2009) and the functions of gold as safe havens (Upper, 2000; Kaul and Sapp, 2007). Even though Capie, Mills and Wood (2005) have analyzed the role of gold as a hedge, their research is limited to investigate the condition of gold against the U.S. dollar. That is, they only consider the role of gold as a hedge for exchange rate risk.

It is not until recently that Baru and Lucey (2010) have examined the position of gold as a hedge or a safe haven for stocks and bonds in bull and bear markets, whilst they only check the impacts of stocks and bonds on gold, none the reverse. However, to the best of our knowledge, the fluctuations of financial markets are interactive (Cheung and Mak, 1992; Ibrahim, 2006; Iwatsubo and Inagaki, 2007). Namely, the variations among gold, stocks and bonds might be related (as described in Figure 1). Accordingly, the role of gold could no longer be a hedge or safe haven; that is, gold may be none of them (Sumner, Johnson and Soenen, 2010). But seldom paper has analyzed the interrelation among the previous three financial products so far.
Besides, from Figure 1, we can also see that there seems to have some kind of relatedness between oil price and gold price/stocks/bonds. When global financial crisis in 2008 being

used as a partition point, it shows that the price of oil shows a stable rising trend before 2008, and attains a peak in July 3 2008. But since then, oil price has nosedived and fell to the low band in 19 December 2008. During this six-month period, the oil price plummeted by 77%. At the same time, the prices of stocks and gold also decrease, whilst those of bonds index are the reverse. We therefore suggest that the fluctuations of oil prices have impacts on that of gold, stocks and bonds.

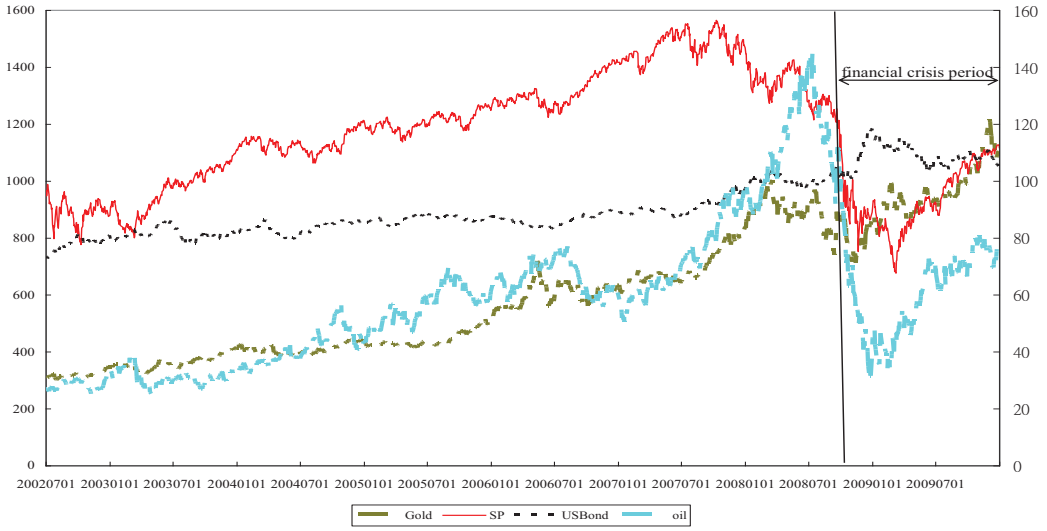


Figure 1 Daily price trend on the stock, bond, gold and oil, July 2002-December, 2009.

Of course, the burst out of subprime mortgage crisis, that is, the bankruptcy of Lehman Brothers Holdings Inc. declared on September 15 2008, may have altered the structure of financial market and have spillover influences on financial products. That is, in addition to stocks, bonds and gold price could also be affected by the subprime mortgage crisis.

Accordingly, the main purpose of this paper is to employ a multivariate GARCH Baba-Engle-Kraft-Kroner (BEKK) model defined in Engle and Kroner (1995) to examine the interrelationship among stocks, bonds and gold along with the role differences played by gold in full sample and subsample period (post-subprime mortgage crisis). In other words, this paper would to analyze whether investors would flee from stocks and bonds investment and get into gold products when stock and bond market exhibits severe losses (Gulko, 2002; Hartmann, Straetmans, and de Vries, 2004; and Baur and Lucey, 2009). In this way, we could learn if gold serves as a good hedge or safe haven instrument when the financial market reverses.

Our empirical results show that gold is a feedback hedge for stocks for the full sample of data. However, the hedge relationship between gold and bonds is unidirectional. Gold can store value only in normal financial market. During the financial crisis period, gold is a good safe haven for bonds, not for stocks. But gold no longer owns the ability to store value. Besides, even if the way, degree and duration are not similar, the impulse responses among gold, stocks and bonds markets are short-term. Generally, gold is a suitable tool to hedge against the stock market; whilst throughtout the financial crisis period, gold is not a safe haven.

The remainder of this paper is organized as follows. Descriptions of the related data and the empirical methodology adopted for this study are provided in Section 2, followed in the penultimate section by presentation of our empirical results. Finally, the conclusions drawn from this study are summarized in the closing section.

DATA AND METHODOLOGY

Data

The analyses of interrelation among stock, bond and gold price along with the influences of oil price and subprime mortgage crisis are based upon the daily closing price of S&P 500 stock index, New York gold market (USD/ounce), West Texas intermediate crude oil (USD/barrel) and U.S. bond index. The former three data are obtained from the Taiwan Economic Journal (TEJ), and the last one is obtained for Bloomberg. The sample period for the study covers seven and half years, from July 1, 2002 to December 31, 2009, with a total sample of 1,838 observations. Besides, we define the subprime financial crisis period as the span from September 16, 2008 to December 31, 2009, including 314 observations. All the analysis is conducted on return data.[4]

Methodology

1. Multivariate GARCH Model

As the main purpose of this paper is focused on the dynamic relationship among stock, bond and gold along with the exogenous effects from oil price and subprime mortgage crisis, we apply a multivariate GARCH model to analyze their correlation and related impacts. An important preliminary step in model building is the selection of the lag order. In order to eliminate the autocorrelation of residual, we use some commonly used lag-order selection criteria to choose the lag order, such as AIC (Akaike Information Creteria).

$$AIC = -2\left(\frac{Log L}{T}\right) = \frac{2k}{T} \tag{1}$$

Base on AIC, the lag order we chosen is 2 for the three series in the study. Because the data we used are daily data, the result is reasonable. The empirical model can be constructed as follows.

$$\begin{aligned} G_t = {} & \beta_{G0} + \sum_{k=1}^{2}\beta_{G1k}G_{t-k} + \sum_{k=1}^{2}\beta_{G2k}S_{t-k} + \sum_{k=1}^{2}\beta_{G3k}B_{t-k} + \sum_{k=1}^{2}\beta_{G4k}O_{t-k} + \\ & D\times\left(\gamma_{G0} + \sum_{k=1}^{2}\gamma_{G1k}G_{t-k} + \sum_{k=1}^{2}\gamma_{G2k}S_{t-k} + \sum_{k=1}^{2}\gamma_{G3k}B_{t-k} + \sum_{k=1}^{2}\gamma_{G4k}O_{t-k}\right) + \varepsilon_{G,t} \end{aligned} \tag{2}$$

[4] Unit root tests are conducted for stock, bond, gold and oil series. As the results show that the four series have unit roots, we use first-order difference (return) to implement our empirical study. To save space, related results are not shown here. All results are available on request.

$$S_t = \beta_{S0} + \sum_{k=1}^{2}\beta_{S2k}S_{t-k} + \sum_{k=1}^{2}\beta_{S1k}G_{t-k} + \sum_{k=1}^{2}\beta_{S3k}B_{t-k} + \sum_{k=1}^{2}\beta_{S4k}O_{t-k} + D\times\left(\gamma_{S0} + \sum_{k=1}^{2}\gamma_{S2k}S_{t-k} + \sum_{k=1}^{2}\gamma_{S1k}G_{t-k} + \sum_{k=1}^{2}\gamma_{S3k}B_{t-k} + \sum_{k=1}^{2}\gamma_{S4k}O_{t-k}\right) + \varepsilon_{S,t} \quad (3)$$

$$B_t = \beta_{B0} + \sum_{k=1}^{2}\beta_{B3k}B_{t-k} + \sum_{k=1}^{2}\beta_{B1k}G_{t-k} + \sum_{k=1}^{2}\beta_{B2k}S_{t-k} + \sum_{k=1}^{2}\beta_{B4k}O_{t-k} + D\times\left(\gamma_{B0} + \sum_{k=1}^{2}\gamma_{B3k}B_{t-k} + \sum_{k=1}^{2}\gamma_{B1k}G_{t-k} + \sum_{k=1}^{2}\gamma_{B2k}S_{t-k} + \sum_{k=1}^{2}\gamma_{B4k}O_{t-k}\right) + \varepsilon_{B,t} \quad (4)$$

$$\begin{bmatrix}\varepsilon_{G,t}\\ \varepsilon_{S,t}\\ \varepsilon_{B,t}\end{bmatrix}\Big|\,\Omega_{t-1} \sim N(0, H_t) \quad (5)$$

$$H_t = \begin{bmatrix} h_{GG,t} & h_{GS,t} & h_{GB,t}\\ h_{SG,t} & h_{SS,t} & h_{SB,t}\\ h_{BG,t} & h_{BS,t} & h_{BB,t}\end{bmatrix} \quad (6)$$

where G_t, S_t, B_t and O_t denote the returns of gold, S&P 500 index, U.S. bond index and West Texas crude oil at time t, respectively. D is a dummy variable, representing the occurrence of subprime mortgage crisis. If the date is after September 15, 2008, then D is 1; otherwise zero. ε_T is the error term, H_t is defined as the covariance matrix, Ω_{t-1} represents the information set at period $t-1$. The individual factors in the covariance matrix are stated as below.

$$h_{GG,t} = c_{11}^2 + a_{111}^2\varepsilon_{G,t-1}^2 + g_{111}^2 h_{GG,t-1} \quad (7)$$

$$h_{GS,t} = c_{11}c_{12} + a_{111}a_{122}\varepsilon_{G,t-1}\varepsilon_{S,t-1} + g_{111}g_{122}h_{GS,t-1} \quad (8)$$

$$h_{GB,t} = c_{11}c_{13} + a_{111}a_{133}\varepsilon_{G,t-1}\varepsilon_{B,t-1} + g_{111}g_{133}h_{GB,t-1} \quad (9)$$

$$h_{SS,t} = c_{12}^2 + c_{22}^2 + \left(a_{122}^2 + a_{222}^2\right)\varepsilon_{S,t-1}^2 + \left(g_{122}^2 + g_{222}^2\right)h_{SS,t-1} \quad (10)$$

$$h_{SB,t} = c_{12}c_{23} + c_{22}c_{23} + \left(a_{122}a_{133} + a_{222}a_{233}\right)\varepsilon_{S,t-1}\varepsilon_{B,t-1} + \left(g_{122}g_{133} + g_{222}g_{233}\right)h_{SB,t-1} \quad (11)$$

$$h_{BB,t} = c_{13}^2 + c_{23}^2 + c_{33}^2 + \left(a_{133}^2 + a_{233}^2 + a_{333}^2\right)\varepsilon_{B,t-1}^2 + \left(g_{133}^2 + g_{233}^2 + g_{333}^2\right)h_{BB,t-1} \quad (12)$$

In the above equations, equation (2) to (4) are the mean equations, and equation (7) to equation (12) are the variance equations, respectively. When the estimated coefficients c_{ij}, a_{ijk} and g_{ijk} are significant, it indicates that taking heteroscedasticity into consideration is well done in this paper.

The advantage of this model is that all of the elements in each covariance matrix are the function of its historical data, so the model can be regarded as a positive definite diagonalized vech type. This study uses normal distribution and maximization likelihood estimation (MLE) to estimate the parameters in the model. The logarithmic likelihood function is defined as follows.

$$L(\theta) = -\frac{1}{2}\sum_{t=1}^{T}\left(\ln|H_t| + \varepsilon_t' H_t^{-1}\varepsilon_t\right) \quad (12)$$

where θ represents the parameter vectors needed to be estimated; T is the number of observations.

2. Impulse Response Function (IRF)

An impulse response refers to the reaction of any dynamic system in response to some external change. This paper uses nonlinear GARCH-IRF equation to analyze the impulse response between variables. This method covers the characteristics of volatility varying with time, which can better correspond to the properties of financial assets. Accordingly, by applying nonlinear GARCH-IRF equation to assay the individual shock from the fluctuations of stock, bond and gold markets**,** we can observe the variation and reaction speed of the impulse response in each series and then make correct investment decision.

EMPIRICAL RESULTS

Basic Statistics

The summary descriptive statistics for the daily logarithmic returns of gold, S&P 500 index and bond index over the seven-half-year sample period are presented in Table 1, from which we can see that the mean daily return is found to the highest (lowest) for the gold (S&P 500 index).

Amongst the three indices, the standard deviation of the return is found to be the highest for S&P 500 index. That is, stocks are generally more risky than gold and bonds. Unexpectedly, gold appears relatively risky than bonds in terms of standard deviation, minimum and maximum values. Besides, all of the indices exhibit large kurtosis, and the Jarque-Bera tests for normality revealing that the returns of the three series are non-normal distributed. Therefore, according to the results of the skewness, kurtosis and Jarque-Bera tests, the return distributions of gold, stock index and bond index are more fat-tailed and high-peaked than normal distribution, consistent with the ARCH effect.

Table 1 Summary statistics of the returns of Gold, S&P 500 index and U.S. bond index

Variables	Mean	Standard deviation	Skewness	Kurtosis	Maximum	Minimum	Jarque-Bera	Q(50)
Gold	0.0680	1.2676	-0.2566***	3.8332***	7.7968	-7.8934	1144.8017***	90.199***
S&P 500	0.0077	1.4186	-0.2258***	8.7617***	10.2457	-9.4695	5891.5417***	129.591***
U.S. Bond	0.0200	0.5260	0.0908	3.3546***	3.9281	-2.8228	863.8640***	69.423***

Note: 1. *** represent 1% significant level.
2. The kurtosis examined here is excess kurtosis, which equals to the original kurtosis minus 3.
3. Q (50) is the Q-statistic of the Ljung-Box test.

ARCH effect

Many empirical results, such as Bollerslev (1986), Colm and Patton (2000) and Wang and Wang (2001), all documented that, GARCH (1, 1) model can provide a good fit for the time series data. Accordingly, in this study, the returns of S&P 500 index, bond index and gold will be dealt with via GARCH (1, 1) process.

Before estimating the parameters of GARCH (1, 1) model, we need to test if ARCH effect exists in the residuals resulted from fitting for the model. Consequently, we apply LM test (Lagrange Multiplier test) to examine if ARCH effect exists. If ARCH effect indeed is present, then it is appropriate to match the volatility with GARCH model in this paper. The results in Table 2 show that ARCH effect does exist in the three series.

Table 2 ARCH effect test for the S&P 500 index, U.S. bond index and Gold

Variables	Gold	S&P 500	U.S. Bond
LM test	143.6410***	533.4720***	89.6986***

Note: *** represent 1% significant level.

Empirical analysis of multivariate GARCH model

This paper employs a multivariate GARCH (1, 1)[5] model to explore the relationship among gold, stocks and bonds along with the role acted by gold. In the following, we abide by the definitions of Baur and Lucey (2010) to investigate if gold could serve as a good hedge or safe haven instrument when the financial market reverses. Accordingly, a hedge is defined as gold return that is uncorrelated or negatively correlated with S&P 500 stock return and U.S. bond return; in contrast, a **s**afe haven is described as gold return that is uncorrelated or negatively correlated with S&P 500 stock return and U.S. bond return in times of market stress or turmoil. In addition, as Harmston (1998) has indicated that gold has maintained its value in terms of real purchasing power worldwide in the very long run. Despite price fluctuations, gold has consistently reverted to its historic purchasing power parity with other commodities and intermediate products. That is, gold has been an effective vehicle to store value. Therefore, this paper defines that gold can be as a store of value when the return of gold is positively correlated with oil return. The related empirical results are presented as follows.

1. Sum tests

The empirical results in Panel B of Table 3 show the outcomes of sum test during the whole sample period. It is found that except for the insiginificant impact of gold and bond return on the stock return, others display siginificant causal relationships. Especially, there is a bidirectional causality between gold and bond market, in spite of the marginal significane of

5 When selecting the values for p and q, it is typical to set both parameters equal to 1, and uses a GARCH (1,1) model to proceed empirical analysis. While increasing p and q will invariably increase the fit to in-sample data, as the various models are nested, the advantages gained are minimal and can lead to over specification.

gold on bond return. This means that the spillover effects from gold and bond market to the stock market are weak; oppositely, both gold and bond markets have interaction with each other. This is, stock market seems to act a leading role during our sample period. Finally, crude oil price only has significant impact on gold market.

Panel C in Table 3 is the result of sum test for the financial crisis period. Not surprising, the findings are different from those for the whole sample period. In this term, there are no impacts of stock and bond returns on gold return, but the spillover effects from the gold market to stock and bond market are significant and stronger than non-financial crisis period. Thus it can be seen that the character played by gold is more evident than before. Lastly, the impacts of crude oil price on the three markets are insignificant.

Form the sum test results, we believe that gold and stock along with bond returns may be correlated, that is, gold can be helpful in predicting, to some degree, the stock and bond market trend, inconsistent with the result of Sumner, Johnson and Soenen (2010).

2. The results for total sample period

Table 3 and Table 4 show the results for the mean equation and variance equation in the multivariate GARCH (1, 1) model. The β_G coefficients in the first column of Panel A in Table 3 exhibit the influence of all related variables on the gold return. With regard to the impact of stock return, it is found that β_{G21} is insignificant, showing that there is no impact of lag 1 stock return on gold return; however, lag 2 stock return, β_{G22} (0.0854), has significantly positive effect on gold return. Therefore, gold could be a hedge for stock only in lag 1 period. As for the influence in terms of bond returns, the significant positive coefficients of β_{G31} (0.2770) and β_{G32} (0.2126) indicates that when the bond price falls, the gold price also decreases. In other words, gold may not be a good hedge for bond. In addition, the positive coefficient of β_{G41} (0.1062) and β_{G42} (0.0258) discloses that ascending oil price could also promote the increase in gold price, implying that gold seems to function well in resisting inflation and store value during our sample periods. This finding is consistent with that of Harmston (1998).

The β_S coefficients in the second column of Panel A in Table 3 show the impacts of associated variables on the stock return. The effects of β_{S21} (-0.0880) is significantly negative, revealing that the stock return could be affected by its own lag return. That is, stock return possesses mean-reversion characteristic. Besides, the influences of gold returns on stock returns are insignificant, consistent with the issue that gold is a good hedge for stock, agreeing with the outcome of Baur and Lucey (2010). Further, both of the bond return and oil return have no significant impacts on stock return. This result corresponds to the sum test that stock market plays a leading part during our whole sample period.

The β_B coefficients in the third column of Panel A in Table 3 present the affects of variables on the bond return. Just as the results in the stock return, bond return could also be affected by its own lag return. The significance of β_{B32} (-0.0686) shows that mean-revision phenomenon also exists in the bond market. Moreover, β_{B11} and β_{B12} are both

insignificant, showing that there are no impacts of gold returns on the bond return. Hence, gold is a good hedge for bond. Besides, lag stock return, β_{B21} and β_{B22} has negative impact on the bond return. Hence, bond is also a good hedge for stock market, just like the role of gold. In addition, oil return has no impact on bond return.

Combined with the results of sum test for the whole sample period, this paper finds that gold is a feedback hedge for stock, consistent with the finding of Baur and Lucey (2010); namely, hedge occurs in the bidirection between gold and S&P 500 markets. This result makes gold present diversification benefits for stock investment. However, as to the hedge relationship between gold and bond, it is only unidirectional. That is, when the innovations flow from gold to bond market, the hedge effects just exist; otherwise, the situation reverses. If it the case, because gold and bond price move together, gold is no longer a good hedge for bond. Notably, bond is also a good hedge for stock during our total sample period. As to the relationship between gold and crude oil, the results indicate that gold possesses the function to counter inflation and store value, supporting the finding of Harmston (1998).

Table 3 Estimation results of multivariate GARCH model among Gold, S&P 500 index and U.S. bond index

Panel A					
Parameter	Gold	Parameter	S&P 500	Parameter	U.S. Bond
β_{G0}	0.0354	β_{S0}	0.0629 ***	β_{B0}	0.0180 *
γ_{G0}	0.2174 ***	γ_{S0}	-1.1669 ***	γ_{B0}	0.1529 **
β_{G11}	-0.0358	β_{S21}	-0.0880 ***	β_{B31}	-0.0041
γ_{G11}	0.2378	γ_{S21}	-0.2135 **	γ_{B31}	0.0801
β_{G12}	0.0236	β_{S22}	-0.0273	β_{B32}	-0.0686 ***
γ_{G12}	-0.1255	γ_{S22}	-0.1051	γ_{B32}	0.1083
β_{G21}	-0.0085	β_{S11}	-0.0149	β_{B11}	-0.0075
γ_{G21}	0.1312 **	γ_{S11}	0.1847 *	γ_{B11}	-0.0472
β_{G22}	0.0854 ***	β_{S12}	0.0062	β_{B12}	-0.0110
γ_{G22}	-0.1124 **	γ_{S12}	0.2592 ***	γ_{B12}	-0.0505 *
β_{G31}	0.2700 ***	β_{S31}	-0.0605	β_{B21}	-0.0197 **
γ_{G31}	0.3517 *	γ_{S31}	0.3264	γ_{B21}	0.0760 ***
β_{G32}	0.2126 ***	β_{S32}	-0.0231	β_{B22}	-0.0140
γ_{G32}	-0.4761 ***	γ_{S32}	-0.5641 *	γ_{B22}	0.0918 ***
β_{G41}	0.1062 ***	β_{S41}	-0.0090	β_{B41}	0.0029
γ_{G41}	-0.0684 ***	γ_{S41}	0.0003	γ_{B41}	-0.0202 *
β_{G42}	0.0259 ***	β_{S42}	-0.0058	β_{B42}	0.0001
γ_{G42}	-0.0343	γ_{S42}	-0.0601	γ_{B42}	0.0073

Panel B Sum test for the whole sample period					
Impact of S&P 500 on Gold	6.6931***	Impact of Gold on S&P 500	0.1555	Impact of Gold on Bond	3.1824*
Impact of Bond on Gold	50.8236***	Impact of Bond on S&P 500	2.0782	Impact of S&P 500 on Bond	6.2771**

Impact of oil on Gold	92.4540***	Impact of oil on S&P 500	1.5034	Impact of oil on Bond	0.2746
Panel C Sum test during the financial crisis period					
Impact of S&P 500 on Gold	1.3938	Impact of Gold on S&P 500	12.5108** *	Impact of Gold on Bond	9.5651***
Impact of Bond on Gold	2.0025	Impact of Bond on S&P 500	0.5712	Impact of S&P 500 on Bond	15.6758***
Impact of oil on Gold	0.6023	Impact of oil on S&P 500	1.5024	Impact of oil on Bond	0.2958

Note: ***, ** and * represent 1%, 5% and 10% significant level individually.

3. The results during the financial crisis period

Just as the above mentioned, $\beta_G + \gamma_G$ coefficients in the first column of Panel A in Table 3 show the effects of correlative variables on the gold return. As to the impact of stock return, we find that $\beta_{G21} + \gamma_{G21}$ (0.1227) is significant, whilst $\beta_{G22} + \gamma_{G22}$ (-0.0270) is insignificant, showing that gold is a safe haven for stock only in lag 2. Regarding the effect of bond return, the coefficient estimates is significant in lag 1 ($\beta_{G31} + \gamma_{G31}$=0.6217), while insignificant in lag 2 ($\beta_{G32} + \gamma_{G32}$=-0.2635). This result indicates that gold is also a safe haven for bond in lag 2. That is, gold could be a good safe haven instrument against stock and bond only in lag 2 during financial crisis period. Finally, the insignificance of $\beta_{G41} + \gamma_{G41}$ (0.0378) and $\beta_{G42} + \gamma_{G42}$ (-0.0084) seem to point out that oil return has no crucial impact on gold return during financial crisis period. That is, gold can't work well to store value in this period. Apparently, the effects of stock, bond and oil returns on gold return are different from the whole sample period.

$\beta_S + \gamma_S$ coefficients in the second column of Panel A in Table 3 display the influence of all variables on the stock return. First, as to the impact of gold return, $\beta_{S11} + \gamma_{S11}$ (0.1698) and $\beta_{S12} + \gamma_{S12}$ (0.1987) are both significant positive. Namely, there is a positive relationship between gold and stock index. Hence, gold is not a safe haven for stock, inconsistent with the finding of Baur and Lucey (2010). In term of bond returns, $\beta_{S31} + \gamma_{S31}$ is insignificant; whilst $\beta_{S32} + \gamma_{S32}$ (-0.5872) is significantly negative. These outcomes show that when the financial market suffers drastic danger, the invstors would prefer bonds to stocks, similar to the whole sample period. That is, as there exists tremendous downside risk in the financial market during finanicial crisis period, gold is no longer to be a good safe haven for stocks. Relatively, bonds seems to serve good for stocks. Finally, $\beta_{S41} + \gamma_{S41}$ and $\beta_{S42} + \gamma_{S42}$ are both insignificant, presenting that oil returns have no impacts on the stock return and these results are the same as the whole sample span.

$\beta_B + \gamma_B$ coefficients in the third column of Panel A in Table 3 are the impacts of related variables on the bond return. First, with regard to the impact of gold return, $\beta_{B11} + \gamma_{B11}$(-0.0546) and $\beta_{B12} + \gamma_{B12}$(-0.0615) are significant negative, showing that gold is a good safe haven for bond. Second, as for the influence of stock returns, it is found

that $\beta_{B21}+\gamma_{B21}$ (0.0562) and $\beta_{B22}+\gamma_{B22}$ (0.0778) are both significantly positive, indicating that when the stock returns decrease, the bond returns also reduce during financial crisis period. Namely, there is bidirectional causal relationship between stock and bond returns, which is inconsistent with those of the total sample period. Finally, $\beta_{B41}+\gamma_{B41}$ and $\beta_{B42}+\gamma_{B42}$ are both insignificant, again exhibiting that oil return has no effects on the bond return, similar to that of the whole sample term.

Integrated with the outcomes of sum test for the financial crisis period, it shows that gold is a good safe haven for bond, and the influence of gold on bond is even stronger than before, a result disagreeing with that of Baur and Lucey (2010). Similar to the results in whole sample period, gold could be a safe heaven only when the innovations flow from gold to bond market, not the reverse. As to the impact of crude oil price on gold, the results show that gold no longer possesses the effect to resist inflation and store value.

In brief, there exists some kind of relatedness between gold and stocks and gold and bonds, no matter unidirectional or bidirectional. Moreover, it is addressed that the safe haven role played by gold against bond is more evident during financial tsunami. Besides, the move in oil price can only positively impact that of gold price in total sample period; whilst in financial crunch term, oil price is almost unable to influence that of gold. Namely, gold is a good vehicle to store value and oppose to inflation only in normal financial market.

Conditional variance

Table 4 shows the empirical results of conditional variance in multivariate GARCH (1,1) model. It can be seen that most of c_{ij}、a_{ijk} and g_{ijk} coefficients in Table 4 are significant, indicating that when studying related issues, time-varying variance must be taken into consideration. Further, due to the insignificance of $Q(5)$ and $Q^2(5)$, showing the adequency of this model.

Table 4 The conditional variance of multivariate GARCH model among Gold, S&P 500 index and U.S. bond index

c_{11}	-0.1130 ***	a_{111}	-0.2118 ***	g_{111}	0.9728 ***
c_{12}	0.0367	a_{122}	-0.0790	g_{122}	0.7363 ***
c_{13}	0.0091	a_{123}	-0.0145	g_{123}	0.7501 ***
c_{22}	-0.0963 ***	a_{222}	0.2544 ***	g_{222}	-0.6139 ***
c_{23}	0.0080	a_{233}	0.1787 ***	g_{233}	-0.6342 ***
c_{33}	-0.0240 **	a_{333}	-0.0000	g_{333}	0.0000
Q test	Gold	Q test	S&P 500	Q test	U.S. Bond
Q(5)	0.427	Q(5)	0.719	Q(5)	2.241
$Q^2(5)$	1.107	$Q^2(5)$	5.959	$Q^2(5)$	3.831
log-likelihood function	-6506.4562				

Note: 1. *** and * represent 1% and 10% significant level individually.
2. The Q(5) and $Q^2(5)$ statistics denote the Ljung-Box for the residuals and the squared residuals in the model with 5 lags, respectively.

Impulse response analysis

Although the causality tests can provide the evidence in direction of causality, it is unfortunately that these results still can't reveal the intertemporal dynamic effects among gold, stocks and bond. However, the intertemporal dynamic information can be displayed via impulse response analysis. Because according to the style of impulse response, we can judge the lasting time, direction and magnitude of innovation.

Figure 2 to 4 present the 24-period responses of, respectively, gold, stock and bond price to shocks in other variables using the full sample span. The results are generally intuitive. First, as to the impulse from the gold market, we note that one unit impulse from gold market on gold return has a maximum positive value (1.2059) in period 0. In period 1, the response turns into negative value (-0.0451). Then the impulse response shows a decay to zero after period 3. Besides, one unit impulse from gold market on stock return attains its highest value (-0.1099) in period 2. After that, the impact gradually decreases. In addition, one unit impulse from gold market on bond return reaches its highest value (0.0250) in period 2. From then, the impact progressively decreases to zero.

Second, with regard to the impulse from the stock market, it is found that one unit impulse from stock market on gold return reached its highest value (0.0820) in period 2. Then the impulse effect is weaker and decays to zero afterward. Moreover, one unit impulse from stock market on stock return attains its highest value (1.3589) in period 0. Since that, the impact also decreases to zero slowly. Further, one unit impulse from stock market on bond return is the highest (-0.1694) in period 0. The impact also diminishs to to zero bit by bit.

Third, regarding the impulse from the bond market, the figure tells that one unit impulse from bond market on gold return has maximum positive reaction (0.1323) in period 2. Then the impulse response shows a decay to zero after period 2. Basides, the impacts of impulse from bond market to stock return are smaller than others. Surpringly, the impulse from bond market on bond return has a maximum value of 0.4901 in period 0. Then the impulse response shows a decay to zero afterward.

Joined the results of impulse response among gold, stocks and bond, this paper finds that the greatest impulse response in period 0 occur in the situation when the innovation arises from themselves market. Second, the impulse responses of individual market return on the other two market returns almost have persistence of at most 2 periods and then decays after the period, although their direction, extent and duration are not similar. Third, the impact of impulse response disappear quickly. Therefore, this paper documents that there are short-term impulse responses among gold, stock and bond markets but no long-term effects.

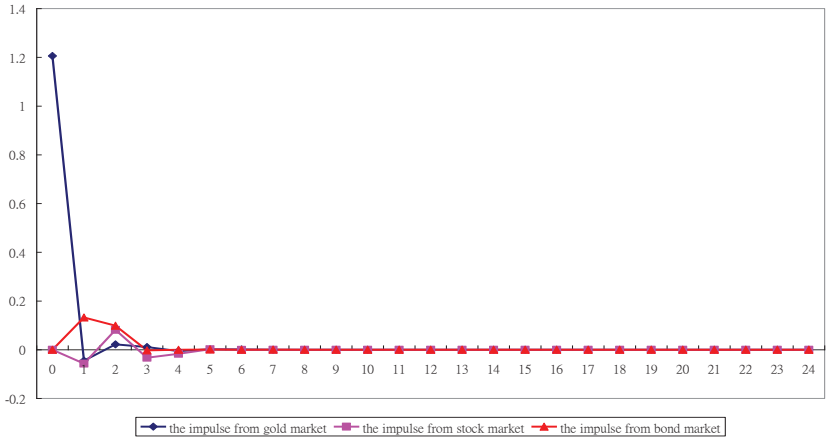


Figure 2. The impulse response of gold return

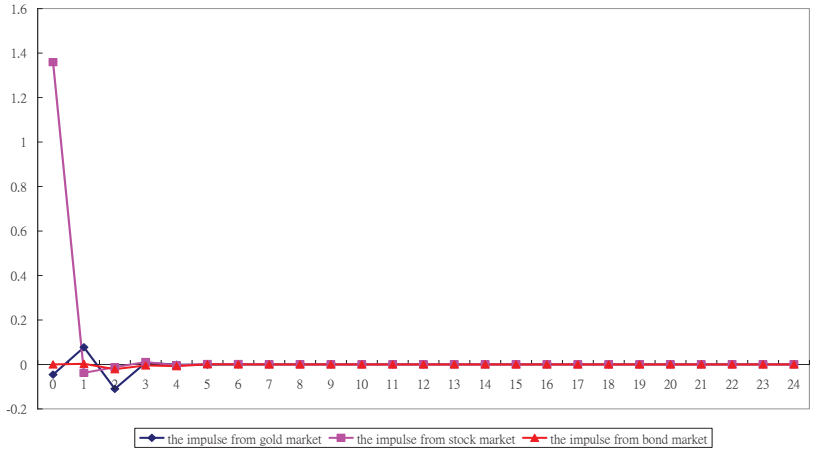


Figure 3. The impulse response of stock return

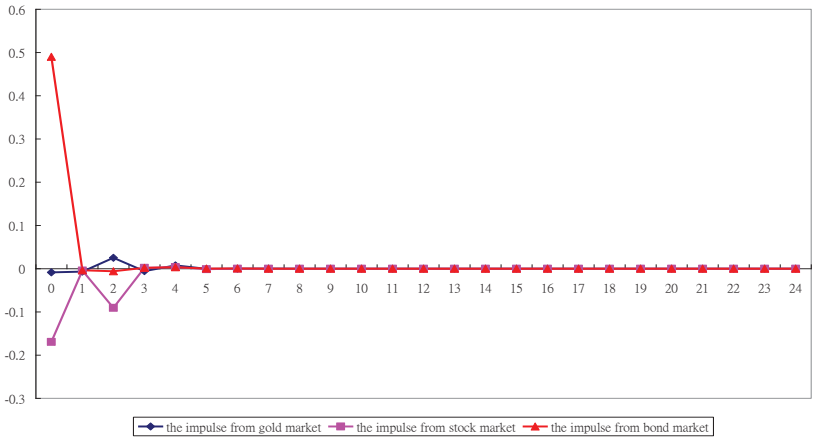


Figure 4. The impulse response of bond return

CONCLUSION

The bankruptcy of Lehman Brothers Co. in September 2008 leads to a global financial crisis and generates serious impacts on the world economy. For a long time, stocks and bonds in general have been the major assets for investment purposes. Instead, gold has often been regarded as a safe hedge or counter-cyclical investment vehicle. To explore the possible variation in financial market, this paper employs a multivariate GARCH Baba-Engle-Kraft-Kroner (BEKK) model to analyze the interdependence among gold, stock and bond price during whole sample period and financial crisis period. Besides, we further check the relationship between gold and oil price to see if gold could function well to store value in our sample span. In this way, we can not only learn the role that gold acts, a hedge, safe haven or nothing, but also how well that gold operates to preserve value. In addition, by the analysis of impulse response, this paper could also observe the direction, extent and duration of impulse response among gold, stock and bond returns.

The empirical results show several findings among them. For the full sample of data examined, this paper shows that gold is a feedback hedge for stock, hedge occurs in the bidirection between gold and S&P 500 markets. Therefore, gold could present diversification advantage for stock investment. But the hedge relationship between gold and bond is only unidirectional. As to the association between gold and oil price, it is found that gold possesses the function to store value, supporting the finding of Harmston (1998). During the financial crisis period, it is showed that gold is a good safe haven for bond only when the innovations flow from gold to bond market, not the reverse. Besides, whenever there is enormous downside risk in the financial market, such as the financial crisis term, gold is no longer a safe haven for stocks. On the contrary, bonds could function well for stocks. With regard to the impact of oil price on gold, the results propose that gold no longer owns the ability to store value.

In adddition, even though the way, degree and duration are not the same, this paper proposes that the impulse responses of individual market return on the other two market returns have persistence of at most 2 periods and decay quickly. Therefore, it is documented that the impulse responses among gold, stock and bond markets are short-lived, not long-term.

In brief, there exists some kind of relatedness between gold and stocks and gold and bonds, no matter unidirectional or bidirectional. Generally, gold is a suitable tool to hedge against the stock market; whilst when financial crisis occurs, gold and stock price usually shift in the same direction. Hence, gold is not certainly a safe haven. Besides, the move in oil price can only positively effect that of gold price in total sample period; in financial crunch term, oil price is unable to influence that of gold. Namely, gold is a good vehicle to store value and oppose to inflation only in normal financial market.

REFERENCES

1. Bollerslev, T., 1986, Generalized Autoregressive Conditional Heteroskedasticity, *Journal of Econometrics*, 31, 307-327.
2. Capie.F., T.C. Mills, and G. Wood, 2005. Gold as a Hedge against the dollar, *Journal of International Financial Markets, Institutions and Money* 15(4), 343–352.
3. Cheung, Yan-Leung and Mak, Sui-Choi, 1992. The International Transmission of Stock Market Fluctuation between the Developed Markets and the Asian-Pacific Markets, *Applied Financial Economics*, 2(1), 43-47.
4. Colm, K. and A.J. Patton, 2000, Multivariate GARCH Modeling of Exchange Rate Volatility Transmission in the European Monetary System, *The Financial Review*, 41, 29-48.
5. Dicky, D. A.and Fuller,W.A. 1979. Distribution of the estimation for autoregressive time series with a unit root, *Journal of American Statistical Association* 74, 427-431.
6. Dicky, D. A. and Fuller, W. A. 1981. Likelihood Ratio Statistic for Autoregressive Time Series with a Unit Root, *Econometrica* 49, 1057-1072.
7. Dirk G. B. and Brian M. L., 2010. Is Gold a Hedge or a Safe Haven? AnAnalysis of Stocks, Bonds and Gold, *The Financial Review* 45, 217–229.
8. Dirk G. B. and Thomas K. McDermott, 2010. Is gold a safe haven? International evidence, *Journal of Banking & Finance* 34, 1886–1898.
9. Draper P., Faff R. and Hillier D., 2006. Do Precious Metals Shine? An Investment Perspective, *Financial Analysts Journal* Vol.62, No.2, 98-106.
10. Engle R.F., 1982, Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflations, *Econometrics*, 50, 987-1008.
11. Engle R. F. and Granger C. W. J., 1987, Co-integration and error correction: Representation, estimation and testing. *Econometrica* 55, 251-276.
12. Engle R.F. and K.F. Kroner, 1995, Multivariate Simultaneous Generalized ARCH, *Econometric Review*, 11, 122-150.
13. Engle R. F. and Yoo, Byung Sam, 1987. Forecasting and testing in co-integrated systems. *Journal of Econometrics,* Elsevier 35(1), 143-159.
14. Graham, S. 2001. The price of gold and stock price indices for the United States, *World Gold Council*.
15. Granger, C.W.J., 1986. Developments in the Study of Cointegrated Economic Variables. *Oxford Bulletin of Economics and Statistics 48*, 213-228.
16. Granger, C. and P. Newbold, 1974. Spurious Regression in Econometrics. *Journal of Econometrics* 2, 111-120.
17. Gulko, L. 2002. Decoupling: If the U.S. treasury repays its debt, what then? *Journalof*

Portfolio Management 28(3), 59–66.

18. Hamilton, James D. 1996. This is what happened to the oil price-macroeconomy relationship, *Journal of Monetary Economics* 38, 215-220.
19. Hammoudeh, S. and Yuan, Y. 2008, Metal volatility in presence of oil and interest rate shocks, *Energy Economics*, 30(2), 605.
20. Harmston, S. (1998) Gold as a Store of Value, London, World Gold Council.
21. Kolluri, B.R. 1981. Gold as a hedge against inflation : An empirical investigation, *Quarterly Review of Economics and Business* 21, 12-24.
22. Kyongwook Choi, Shawkat Hammoudeh, 2010. Volatility behavior of oil, industrial commodity and stock markets in a regime-switching environment, *Energy Policy* 38, 4388–4399.
23. Mishra, Banamber and Matiur Rahman, 2005. The Dynamics of Bombay Stock, US Stock and London Gold Markets, *Indian Journal of Economics and Business* 4(1), 151-60Newey.
24. Ngama, Y.L., 1994, Testing for the Presence of Time-Varying Risk Premium Using a Mean-Conditional-Variance Optimization Model, *Oxford Bulletin of Economics and Statistic*, 56, 189-208.
25. Nikos K. 2006. Commodity Prices and the Influence of the US Dollar.
26. Nelson, C. and Plosser, C., 1982. Trends and Random Walks in Macroeconomics Time Series: Some Evidence and Implications. *Journal of Monetary Economics* 10, 139-162.
27. Papapetrou, E. 2001. Oil Price Shocks, Stock Market, Economic Activity and Employment in Greece. *Energy Economics* 23, 511-532.
28. Paresh Kumar Narayan, Seema Narayan , Xinwei Zheng, 2010. Gold and oil futures markets: Are markets efficient? *Applied Energy* 87, 3299–3303.
29. Park, J., 2001, Information Flows Between Non-Deliverable Forward（NDF） and Spot Markets: Evidence from Korean Currency, *Pacific-Basin Finance Journal*, 9, 363-377.
30. Phillips, P.C.B. and P. Perron, 1988. Testing for a Unit Root in Time Series Regressions *Biometrika* 75, 335-346.
31. Robert Faff and Howard Chan .1998, A multifactor model of gold industry stock returns evidence from the Australian equity market, *Applied Financial Economics*, 8, 21 - 28.
32. Sadorsky, P. 1999. Oil Price Shocks and Stock Market Activity, *Energy Economics* 21(5), 449-469.
33. Said, S. and Dickey, D. 1984. Testing for Unit Roots in Autoregressive-Moving Average Model of Unknown Order. *Biometrica* 71, 599-607.
34. Sumner, S., Johnson, R., and Soenen, L., 2010, “Spillover Effects between Gold, Stocks, and Bonds,” Journal of CENTRUM Cathedra, 3(2), 106-120.
35. Tully, E. and Lucey, B. M., 2007. A power GARCH examination of the gold market. *Research in International Business and Finance*, Elsevier 21(2), 316-325.

36. Wang, P. and P. Wang, 2001, Equilibrium Adjustment, Basis Risk and Risk Transmission in Spot and Forward Foreign Exchange Markets, *Applied Financial Economics*, 11, 127-136.
37. Yu, S.W., 2001, Index Futures Trading and Spot Price Volatility, *Applied Economics Letters*, 8, 183-186.
38. Yue-Jun Zhang, Yi-MingWei, 2010. The crude oil market and the gold market: Evidence for cointegration, causality and price discovery, *Resources Policy* 35, 168–177.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

WARRANT SEOS IN AN EMERGING MARKET: EVIDENCE FROM THAILAND

Dr. Polwat Lerskullawat, Faculty of Business Administration, Kasetsart University, Bangkok 10900, Thailand,
fbuspwl@ku.ac.th

ABSTRACT

Eckbo et al. (2006) point out that Seasoned Equity Offering (SEO) companies need to concern for flotation costs, both of direct and indirect, when issuing newly shares. Previous literatures (i.e. Burton et al., 1999; Masulis and Shivakumar, 2002; Corwin, 2003; and Walker and Yost, 2007), considered mainly stock price reaction and underpricing mostly in the U.S. and other developed markets. In contrast, there is paucity of literature on SEOs in Asian markets. The purpose of this paper is to extend our empirical works on Seasoned Equity Offering (SEO) in Thailand, particularly on the areas of stock price reaction and the post-issuing performance. Instead of common stock offerings, we identified 47 firms (of 173 SEO companies) issuing newly shares via warrants between 1999 and 2006. We found that there is a negative reaction of stock prices to SEO announcements. This outcome is consistent to our prior research on common stock issuing companies. With warrant issuing, the SEO firms are impacted by the offering dilution, in comparison with those issuing via common stocks. As these preliminary consequences in the first context, we propose to pay more attention in order to examine the post-issuing performance of warrant SEO firms.

Keywords: Warrants, SEO, Stock Price Reaction, Thailand, Event Study

INTRODUCTION

Since equity offerings (via common stocks) lead to the possibility of the occurrence of dilution, issuing firms can reduce this danger by issuing warrants, giving shareholders the right to buy stocks back when they believe that it is the right time (exercise warrants). Regarding our SEO sample of 173 Thai companies during the period 1999 to 2006, more than 25% of these firms issued new shares by warrants, instead of common stocks. Warrants, together with right issuing and private placement, are one of the three popular issuing methods, and several listed companies on the Stock Exchange of Thailand (hereafter: SET) have recently shown a preference for these.

Eckbo et al. (2006) indicate that although there is no resolution on the issue of a security announcement (which remains inconclusive in the area of an expected flotation cost), a decline in the issue price may be the outcome of a typical negative announcement effect. Nevertheless, the arguments of much literature in this area (e.g. Asquith and Mullins, 1986; Denis, 1994; Corwin, 2003; Walker and Yost, 2007) focus on common stock offering in developed markets. Hence, we propose to investigate something different: warrant SEOs in an emerging market (Thailand). Our study can claim to be the first paper to examine a relevant period in this area in the ASEAN region, with a focus on Thailand. This leads to our motivation to have more knowledge of whether evidence of the common stock issuing firms is consistent in warrant issuing companies.

The paper is organised as follows: section 2 will discuss the relevant literature and hypotheses. Section 3 will clarify the data and methodology, followed by the empirical results in section 4. The investigation is concluded in section 5.

LITERATURE REVIEW AND HYPOTHESES

Literature on Warrant Issuing

Two similar securities can be utilised for issuing new shares apart from common stocks. These are warrants and convertible bonds. Several studies in this area, especially in developed markets (e.g. the U.S.), mainly focus on convertible bonds, as they can be publicly issued, cannot be sold separately and can be issued with other securities. We begin with the study by Singh et al. (1991), who compare underwritten and non-underwritten convertible bond calls that have an effect on stock price. Their results demonstrate that a small portion of the negative average stock price reaction to underwritten calls can only be explained by the direct costs of using underwriters (Singh et al., 1991, p.193). Stein (1992) shows that some factors regarding convertible issues are consistent with the theory: i.e., the negative announcement effect is normally caused by issuing convertible bonds rather than equities.

The utilisation of warrants in initial public offerings (IPOs), Dunbar (1995, p.76) shows that when warrants are issued to compensate an underwriter, the offering costs are effected negatively and lead to a minimisation of costs. A similar examination made by Chemmanur and Fulghieri (1997) shows that the firm insider is allowed to obtain underpricing in order to reduce the costs of maintaining equity after a risky IPO. Subsequently, warrants are included in the issue package. Due to the lower coupon rate, Billingsley and Smith (1996) argue that convertible bonds are chosen when the potential dilution increases and there is a negative reaction from stockholders. According to blue sky regulation, Ng and Smith (1996, p.380) clarify that when firms have high return volatility, a high rate of expected stock price appreciation and substantial growth opportunity, it may be pointless to utilise warrants.

Lewis et al. (1998) examine how convertible bonds are designed by a firm's managers. Their paper shows that the shorter the call protection period, the more managers gain the private information. Moreover, there are reductions in the expected costs of financial distress and the high negative common stock announcement effects when issuing convertible bonds (Lewis et al., 1998, p.39). Mayer (1998) suggests that a sequential financing problem can be resolved by applying the convertible feature. In addition, the exercise of real investment options should be financed in order to complete the convertible bond contract (Mayer, 1998, p.101). Examining the hypothesis of sweetens debt issues; Mann et al. (1999) indicate that the choice of convertible debt has no relationship with the level of volatility in the equity market. In addition, convertible debt is more preferable when there is an increase in interest rates and when there is a bull market (Mann et al., 1999, p.105).

Concerning examination of the signalling hypothesis, Ederington and Goh (2001, pp.470-471) reject this because: (1) there is an accumulation of equity in the accounts of calling firm managers and (2) an increase in purchasing surrounding the calling months. Lewis et al. (2001, p.466) examine all domestic convertible debt in the U.S. between 1979 and 1990, and claim in their findings that convertible debt is preferred by issuers to common stocks when

there is a better cash flow operating performance. Utilising the Buy-and-Hold Returns and calendar time portfolio approaches, Brick et al. (2004) find no strong evidence to support the asymmetric information and liquidity hypotheses for announcement of a conversion-forcing call. This implies that the negative reaction to this announcement is caused by different factors and is something of a puzzle (Brick et al., 2004, pp.20-21). Korkeamaki and Moore (2004, p.404) indicate that when convertibles are issued with weaker call protection, there will be subsequent capital expenditures of those firms after the issuance. Firms with lower levels of capital investment after the issuance of convertibles also have a longer call protection period (Korkeamaki and Moore, 2004, p.404).

Motivations and Hypotheses

We have been motivated to examine SEO stock price reactions with warrant issuing and, subsequently, their post-issuing performance for three reasons. First, a paucity of research on emerging markets is the main gap identified in our literature review. Second, we employ a different database, leading to a difference in institutional background (Lerskullawat, 2012, p.120[1]). Finally, we expand our study to an area which, according to our literature review, no research has focused on; namely, warrant issuing in the case of Thailand with more recent data from between 1999 and 2006.

The existing studies of Thailand (e.g. Jirasetthakulchai, 2000; Lertsupongkit, 2002; Vithessonthi, 2008; Lerskullawat, 2012) specifically focus on common stock offering and use an older data period than our research[2]. Since there was a substantial rise in the number of SEOs in Thailand between 1999 and 2006, with more than 25 per cent of these firms issuing new shares with warrants, it is interesting to investigate the SEO stock price reactions to warrant issuing and whether the conclusions are similar to works on common stock offerings (which react negatively to SEO announcements). Although Thailand has different institutional backgrounds compared to other markets (e.g. small size, dependent on external and technical factors, and with a high number of individual investors), its differences should not lead to an expectation of any specific results in the area of SEO stock price reaction and offering dilution (Lerskullawat, 2012, p.121). Therefore, our hypotheses will be developed following the previous research as:

$H_{0,1}$: There is a negative impact of security prices on the SEO announcement with warrant issuing.

$H_{0,2}$: There is a negative sign of the percentage of average offering dilution.

The literature review demonstrates that the majority of studies focus on the issuance of convertible bonds, rather than warrants, in the U.S. market. It is clear that no research (based on our review) has considered emerging markets. Consequently, it is interesting to study whether an examination of emerging markets is consistent with those of developed ones. However, in Thailand warrant issuing is a more popular issuing method than convertible bonds if companies prefer to issue new shares in a different way than common stock issuing methods (namely, rights issuing, private placement, stock dividend and public offering). This is because companies issuing bonds in Thailand need to pass a credit rating process, which takes a long time to complete. If the company receives a low rating, the interest rate will be

[1] The institutional backgroud in Thailand in this case is based on the period from 1997 to 2007.
[2] The work by Lerskullawat (2012) is excluded from this case.

high. This leads to the possibility of junk bonds. In contrast, in the process of issuing warrants in Thailand it is unnecessary to pass the credit rating and the process is also similar to common stock issuing[3]. Thus, warrants are frequently chosen by SEO firms instead of issuing via common stocks.

For the above reasons, we will examine stock price reaction and offering dilution with the sample of warrant issuing in Thailand between 1999 and 2006.

DATA AND METHODOLOGY

Data Descriptive

Applying the same data set as Lerskullawat (2012), we have obtained our SEO data mainly from the SET fact books and SET database (SETSMART) relating to the period from 1999 to 2006. The financial statements and financial ratios were obtained from Thomson One Banker. The initial sample from these sources comprises 251 non-financial firms with 1,910 SEOs. We exclude financial companies (including banks and insurance firms) because of the differences in their asset structures. Among these 251 firms, we follow the data organisation in Seiler (2004), who utilised the event window to 15 days before and after the event – the SEO announcement date refers to day 0. For the estimation period, Seiler (2004) employs 100 days before the event window. In order to arrange our initial data to cover a longer period around the event date, we extend the 100 days of the estimation period after the event window. Consequently, our focused event study period is 115 days.

Any firms that contain SP or suspension signs and unavailable data for trading information (i.e. closed prices) are also excluded from our sample. To avoid any overlapping in our sample, we use the first SEO of each company. As a result, we have a final sample consisting of 173 companies. Unlike Lerskullawat (2012), we utilised a sample of 47 warrant offering companies during our study period 1999 to 2006. Although the sample of 47 firms is obviously small in comparison with the existing research on developed markets (such as the 863 firms of D'Mello et al., 2003 and the 438 of Walker and Yost, 2007), it is consistent with the number used for Thailand and other emerging markets. Some examples of this literature are Salamudin et al. (1999), Prangthawat (2002), Lertsupongkit (2002) and Marisetty et al. (2008).

Methodology

In order to compare the empirical consequences between the firms issuing common stocks and those issuing warrants, we make the same considerations stated in previous work (e.g. Asquith and Mullins, 1986; Salamudin et al., 1999; Lertsupongkit, 2002; Vithessonthi, 2008), which are the announcement effect and offering dilution.

1. SEO Stock Price Reaction

Methodologies such as market model, event study frameworks, a normal student t-test, ordinary least square (OLS), cross-sectional analysis and the capital asset pricing model

[3] See Lerskullawat (2012, pp.69-105).

(CAPM) are the key ones employed in much of the literature of more recent years; for example, Teoh et al. (1998b), Gajewski and Ginglinger (2002), Aktas et al. (2007) and Brown et al. (2009). Not only these studies which focus on the developed markets, the research in emerging markets and in Thailand are among the studies applying these key methodologies in their estimations (e.g. Bartholdy et al., 2005; Vithessonti, 2008).

We obtain the calculation of abnormal returns (ARs, hereafter) because the ARs are adjusted with the beta of each security (Lerskullawat, 2012).

$$AR_{it} = R_{it} - E(\widetilde{R}_{it}) \qquad (1)$$

where t = day measured relative to the event;

AR_{it} = abnormal return to security i for day t;

R_{it} = return on security i during day t; and

$E(\widetilde{R}_{it})$ = expected rate of return on security i for day t

$E(\widetilde{R}_{it})$ is estimated by the market model, as suggested by MacKinlay (1997)[4]. As a consequence, equation 1 can be rewritten as:

$$AR_{it} = R_{it} - \alpha_{it} - \beta_{it}(R_{mt}) \qquad (2)$$

where R_{mt} = market return on day t (in our case defined as return on the SET index, which is the main composite index in the SET)

α_i = intercept

β_i = the OLS estimators of the market model parameters, calculated in the estimation period.

Since equation 1 is defined, it leads to the measurement of cumulative abnormal return (CAR, hereafter) displayed as:

$$CAR_{i(t_1,t_2)} = \sum_{t=t_1}^{t_2} AR_{it} \qquad (3)^5$$

where t_1 and t_2 are the days between the event window.

We use an event window of 15 days before and after the event, employing day 0 as an event date. Seiler (2004) suggests that, with extremely certain events with little possibility of leakage of information, as little as a plus and minus event window, e.g. ±10 days, can be used. Since there are many speculators and the characteristics of the market in Thailand are helpful for insider trading, a leakage of information might occur. Consequently, it could be worth covering this leakage. In order to pursue this, we extended the event window up to 15 days, as indicated.

We define the offering dilution on the basis of a suggestion by Asquith and Mullins (1986). This defines the discounting of stock prices after issuing, in terms of market capitalisation:

[4] MacKinlay (1997) demonstrates four possible models for measuring normal performance: (1) Constant mean return model – referred to as the simplest model, (2) Market model, (3) Statistical model and (4) Economic model: e.g. CAPM (Capital Asset Pricing Model) and APT (Arbitrage Pricing Model).

[5] The calculation of CAR is based on MacKinlay (1997, p.21).

$$OfferingDilution(\%) = \left(\frac{MktCap_0 - MktCap_{+1}}{MktCap_{+1}} \right) \times 100 \quad (4)$$

where $MktCap_0$ = Market Capitalisation on day of announcement

$MktCap_{+1}$ = Market Capitalisation on the day after announcement.

We claim that our investigation of warrant issuing firms is an expansion of the existing research on common stock offering firms (i.e. Lerskullawat, 2012). Since no evidence of SEO (with warrants) is found in our literature review, our findings could allow us to carry out an examination of SEO in Thailand for one of the most popular issuing method, which is frequently applied in the market.

EMPIRICAL RESULTS

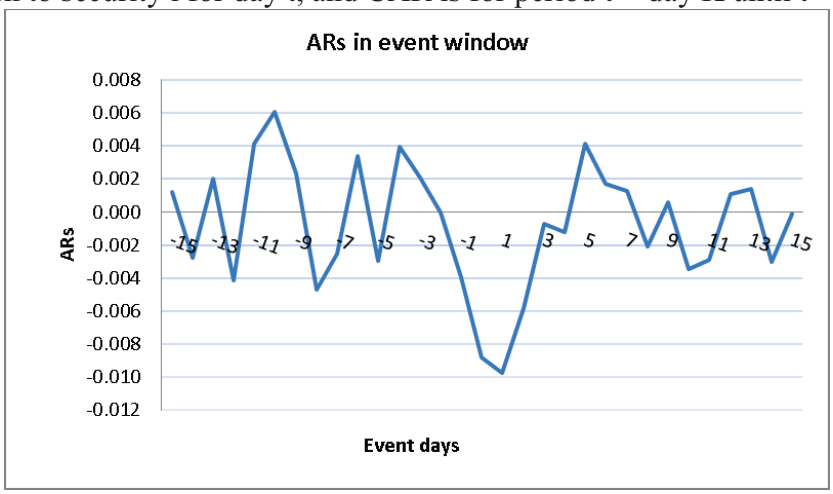
Stock Price Reaction to SEO Announcement

CARs begin to decline substantially in around five days prior to the announcement date (around day -15 to day -10), until the end of our event window. A sharp fall in CARs is clearly seen during the three days before and after the announcement (day 0). However, CARs at the beginning of the event window appear to fluctuate slightly, as demonstrated in Figure 1.

The two-day announcement abnormal returns are statistically significant at a 10% level of confidence, with t-values of -1.74420 on day 0 and -1.68517 on day +1 (see Table 1). These explain why stock prices react negatively to the SEO announcement when the companies use warrants as their issuing method. These outcomes are also consistent with the prior investigation by Lerskullawat (2012) and our hypothesis (Hypothesis 1, see section 2.2) that there is a negative reaction of stock prices to an SEO announcement. Moreover, this evidence shows similar aspects to the existing research on both developed and emerging markets (e.g. Lertsupongkit, 2002; Walker and Yost, 2007). Even though those works on emerging markets (such as Jirasetthakulchai, 2000; Mishra, 2007) are particularly focused on other events, their findings reveal negative reactions to the published information (namely, dividend announcements and stock splits), which is the same as our SEO announcements.

Figure 1: Graphs of abnormal returns and cumulative abnormal returns in event windows

The line graphs show abnormal returns (ARs) and Cumulative Abnormal Returns (CARs) for each relative day during the event window. ARs are calculated by the market model: $AR_{it} = R_{it} - \alpha_{it} - \beta_{it}(R_{mt})$; where R_{it} is the return on security i for day t, and R_{mt} is the return on market. The CARs are calculated by the equation: $CAR_{i,K,L} = \sum_{t=K}^{L} AR_{it}$; where AR_{it} refers to abnormal return to security i for day t, and CAR is for period t = day K until t = day L



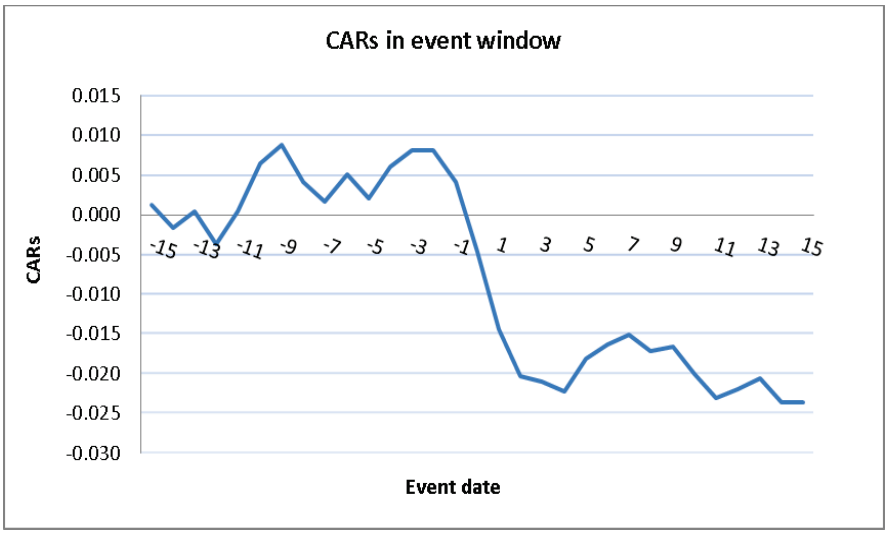


Table 1: Mean abnormal returns surrounding the warrant SEO announcement
The table shows the mean abnormal returns during the event window 15 days before and after the announcement for the total sample of 47 warrant issuing firms. Day 0 refers to the announcement date. The abnormal return (AR) is calculated by the market model: $AR_{it} = R_{it} - \alpha_{it} - \beta_{it}(R_m)$, where R_{it} is return on security i for day t, α_{it} is intercept, β_{it} is the OLS estimators of the market model parameter and R_{mt} is market return on day t (SET index in our case). The t-statistics (t-ratio) are calculated as: $t = \frac{AR_{it}}{S_{AR}/\sqrt{n}}$, where n = sample size, and S_{AR} = standard deviation of AR_{it}.

Event Days	ARs	t-statistics	CARs	Sample Size
-15	0.00119	0.12091	0.00119	47
-14	-0.00280	-0.58325	-0.00162	47
-13	0.00200	0.34078	0.00039	47
-12	-0.00412	-0.41921	-0.00373	47
-11	0.00415	0.65420	0.00042	47
-10	0.00608	0.88327	0.00649	47
-9	0.00232	0.43778	0.00881	47
-8	-0.00470	-0.90418	0.00411	47
-7	-0.00250	-0.65428	0.00161	47
-6	0.00341	0.50216	0.00502	47
-5	-0.00297	-0.60838	0.00205	47
-4	0.00393	0.65621	0.00598	47
-3	0.00209	0.48965	0.00807	47
-2	-0.00001	-0.00247	0.00806	47
-1	-0.00395	-1.10325	0.00411	47
0	-0.00881	-1.74420*	-0.00470	47
1	-0.00976	-1.68517*	-0.01446	47
2	-0.00581	-1.20649	-0.02027	47
3	-0.00072	-0.20690	-0.02099	47
4	-0.00120	-0.17858	-0.02219	47
5	0.00410	0.62234	-0.01809	47
6	0.00171	0.34118	-0.01638	47
7	0.00127	0.17021	-0.01511	47
8	-0.00208	-0.39766	-0.01719	47
9	0.00057	0.12027	-0.01662	47
10	-0.00348	-0.53438	-0.02011	47
11	-0.00291	-0.60891	-0.02302	47
12	0.00110	0.25030	-0.02192	47
13	0.00137	0.36465	-0.02055	47
14	-0.00301	-0.49051	-0.02356	47
15	-0.00010	-0.03122	-0.02367	47

* Significant at 10% level, ** Significant at 5% level, *** Significant at 1% level

Unlike the outcomes of stock price reaction in non-warrant issuing firms (see, for instance, Lerskullawat, 2012), our results in Table 1 show no sign of information leakage prior to the SEO announcement. This is supported by the fact that there are no significant t-values during the pre-event window. Furthermore, our findings are mainly consistent with the previous research on Thailand by Lertsupongkit (2002) and Vithessonthi (2008), in that there is no leakage of information during the event window of SEO announcements. To be more specific, while we report no evidence of leakage information, which is consistent with Vithessonthi (2008), we demonstrate the results of negative stock price reaction to the SEO announcement, which is consistent with the study by Lertsupongkit (2002). Nevertheless, in order to confirm our results of leakage information, Elton et al. (2003) and Seiler (2004) suggest expanding the event window to cover the leakage period in the event study framework. Should we have no evidence of leakage information, we can confirm that the news of warrant issuing are fully published to the public. We thus consider extending our event window by another 15 days to cover the leakage period. Consequently, we have a new event window for our robustness of CARs of 30 days before and after the event date (a 61-day event window).

Robustness of CARs

The outcomes reveal that there are two significant t-statistics on the event dates of -22 and -23 at 10% (see Table 2). These show that evidence of warrant issuing leaks to inside investors prior to the announcement when the event window is extended. Moreover, the t-statistic values are significant on the two-day announcement abnormal returns at 10% (-1.69952 on day 0 and -1.82264 on day 1) – see Table 2. Hence, Hypothesis 1 remains consistent even in the 61-day event window. The CARs graphs fluctuate during the full event window period, showing a sharp rise after the announcement date (see Figure 2). Furthermore, the ARs are not equal to zero in our 61-day event window, allowing investors to obtain them. Therefore, investors are able to use inside information to invest when the SEO firms issue via warrants. This also makes the CARs graphs are slightly different from the CARs graphs of 31-day event window.

In addition, the results in our robustness 61-day event window show a contrast in our previous outcomes regarding leakage information. In other words, we find statistical confirmation that information is leaked prior to the announcement of warrant SEOs when we examine the larger event window (i.e. ±30 days). These cause the t-statistics to be significant around day -22 and day -23 (see Table 2). There could be two reasons to explain how investors can gain abnormal returns before the SEO announcement. The first is the other external factors which impact on stock prices and the second is that the information is leaked prior to the announcement. External factors can include interest rates, exchange rates, unforeseen situations (e.g. political riots and strikes) and the economic figures (i.e. GDP and growth rate announced by the Bank of Thailand), as well as the global situation. Supporting this, the Kasikorn Research Centre (2002)[6] points out that the movements of the major indices (for example, the Dow Jones Index: DJIA) can have an impact on the SET, although there are low correlations between the SET and these major indices, including other markets in the region (except the Japanese and Korean). As a consequence, Lerskullawat (2012)

[6] Kasikorn Research Centre (2002). **SET Index and the Risk of Recession (**in Thai). Vol. 8 Issue 1345, available from the CD-Rom of Kasikorn Research Centre [Access on 25 April 2013].

suggests that a small event window (i.e. ±15 days and ±10 days) is preferable for close consideration and examination of SEO announcements and information leakage in Thailand.

Table 2: Robustness results of 61 day event window

The table shows the mean abnormal returns (mean ARs) during the event window 30 days before and after the announcement (61 day event window) for warrant issuing firms. Day 0 refers to the announcement date. The abnormal return (AR) is calculated by the market model: $AR_{it} = R_{it} - \alpha_{it} - \beta_{it}(R_m)$, where R_{it} is return on security i for day t, α_{it} is intercept, β_{it} is the OLS estimators of the market model parameter and R_{mt} is market return on day t (SET index in our case). The t-statistics (t-ratio) are calculated as: $t = \frac{AR_{it}}{S_{AR}/\sqrt{n}}$, where $n =$ sample size, and $S_{AR} =$ standard deviation of AR_{it} . (*) Significant at 10% level, (**) Significant at 5% level, (***) Significant at 1% level

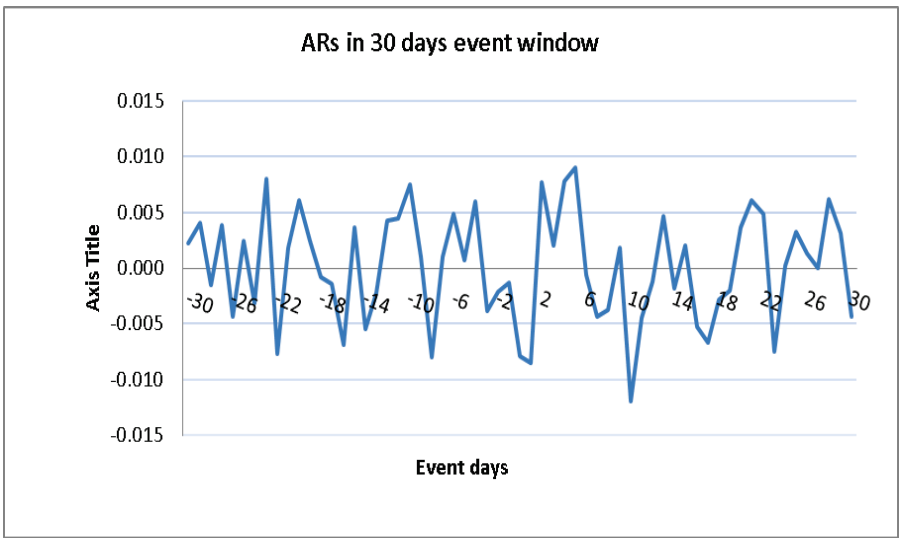
Event Days	ARs	t-statistics	CARs	Sample Size
-30	0.00230	0.46259	0.00230	47
-29	0.00403	0.65368	0.00633	47
-28	-0.00152	-0.44105	0.00481	47
-27	0.00383	0.96095	0.00863	47
-26	-0.00435	-1.28311	0.00428	47
-25	0.00245	0.43628	0.00673	47
-24	-0.00312	-0.97363	0.00361	47
-23	0.00807	1.69907*	0.01168	47
-22	-0.00769	-1.83272*	0.00398	47
-21	0.00186	0.61877	0.00585	47
-20	0.00606	1.41321	0.01191	47
-19	0.00250	0.36122	0.01440	47
-18	-0.00077	-0.13843	0.01363	47
-17	-0.00144	-0.34038	0.01219	47
-16	-0.00685	-0.93396	0.00534	47
-15	0.00371	0.92345	0.00905	47
-14	-0.00545	-1.62581	0.00359	47
-13	-0.00220	-0.53734	0.00139	47
-12	0.00430	0.66623	0.00569	47
-11	0.00451	0.68630	0.01020	47
-10	0.00748	1.04590	0.01768	47
-9	0.00105	0.21538	0.01873	47
-8	-0.00797	-1.47322	0.01076	47
-7	0.00104	0.28750	0.01180	47
-6	0.00484	0.87895	0.01663	47
-5	0.00075	0.16149	0.01738	47
-4	0.00598	1.02011	0.02336	47
-3	-0.00384	-0.98742	0.01952	47
-2	-0.00213	-0.55765	0.01739	47
-1	-0.00129	-0.37017	0.01610	47

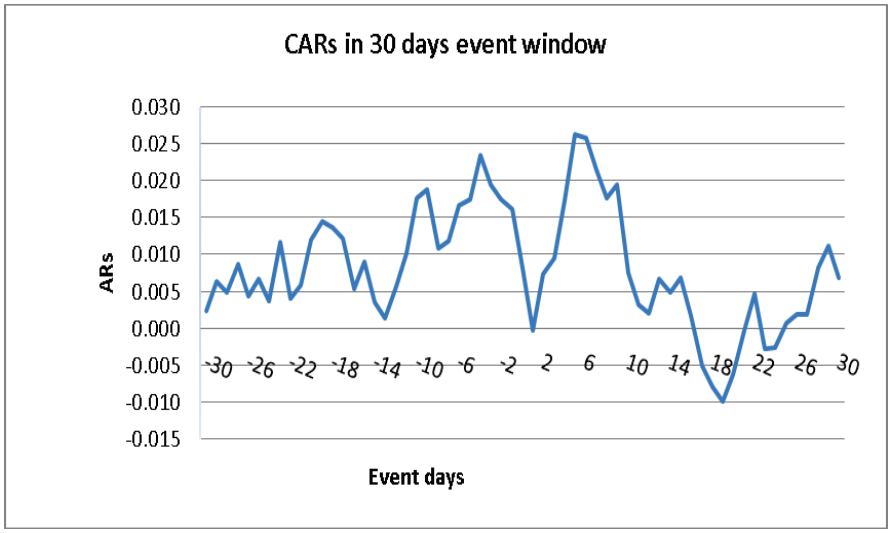
Event Days	ARs	t-statistics	CARs	Sample Size
0	-0.00794	-1.69952*	0.00816	47
1	-0.00852	-1.82264*	-0.00035	47
2	0.00772	1.53912	0.00737	47
3	0.00206	0.59015	0.00943	47
4	0.00781	1.35871	0.01724	47
5	0.00907	1.38127	0.02631	47
6	-0.00055	-0.11379	0.02577	47
7	-0.00430	-0.59130	0.02147	47
8	-0.00378	-0.83627	0.01769	47
9	0.00183	0.47891	0.01953	47
10	-0.01195	-2.14349**	0.00757	47
11	-0.00444	-0.96728	0.00313	47
12	-0.00119	-0.31708	0.00194	47
13	0.00472	1.46179	0.00667	47
14	-0.00179	-0.40161	0.00488	47
15	0.00202	0.61676	0.00690	47
16	-0.00529	-1.29593	0.00161	47
17	-0.00667	-2.10319**	-0.00506	47
18	-0.00284	-0.62621	-0.00790	47
19	-0.00204	-0.53882	-0.00994	47
20	0.00363	0.48184	-0.00631	47
21	0.00608	1.39590	-0.00023	47
22	0.00487	1.01830	0.00464	47
23	-0.00747	-2.17674**	-0.00283	47
24	0.00018	0.04895	-0.00265	47
25	0.00329	0.62896	0.00064	47
26	0.00130	0.39085	0.00194	47
27	-0.00002	-0.00412	0.00192	47
28	0.00617	1.20898	0.00809	47
29	0.00313	0.61654	0.01122	47
30	-0.00438	-1.37261	0.00684	47

* Significant at 10% level, ** Significant at 5% level, *** Significant at 1% level

Figure 2: Graphs of abnormal returns and cumulative abnormal returns in the robustness event window

The line graphs show abnormal returns (ARs) and Cumulative Abnormal Returns (CARs) for each relative day during the event window. The event window is defined as 30 days before and after the event date. ARs are calculated by the market model: $AR_{it} = R_{it} - \alpha_{it} - \beta_{it}(R_{mt})$; where R_{it} is the return on security i for day t, and R_{mt} is the return on market. The CARs are calculated by the equation: $CAR_{i,K,L} = \sum_{t=K}^{L} AR_{it}$; where AR_{it} refers to abnormal return to security i for day t, and CAR is for period t = day K until t = day L.





Offering Dilution

Concerning offering dilution, the value of the firm on announcement day changes by approximately 0.87%, with the minimum percentage of offering dilution by -12.35% (see Table 2). This means that shareholders of warrant issuing firms could lose a maximum of 12.35% in current market values. Furthermore, this 12.35% loss in market value is much less

than the possible maximum loss in the case of common stock offering firms (total sample), which is 22.83% (see Lerskullawat, 2012, p.173). This shows that warrant issuing could help reduce offering dilution during the SEOs. Consequently, our hypothesis of negative average offering dilution (Hypothesis 2, see section 2.2) is rejected. This also implies that the equity value when the issue is announced is less than the post-announcement equity value, indicated by a positive average offering dilution. Therefore, our evidence is certainly inconsistent with Hypothesis 2, in that the average offering dilution is negative. According to the evidence of non-warrant issuing firms (see Lerskullawat, 2012, p.141), the characteristics of the Thai capital market are different from those of developed markets (e.g. Asquith and Mullin, 1986). An example of this can be seen in the method of issuing in Thailand during our study period of 1999 to 2006. While the existing literature concerns SEO samples with public offering, Thai SEO data refer mostly to the issuing of new shares to existing shareholders. Consequently, issuing methods such as rights issuing, private placements and warrants issuing, are widely used, rather than public offering.

Table 3: Offering dilution of warrant issuing firms
The table shows the offering dilution of warrant issuing during the event window. The percentage of the dilution column is defined as the ratio of the change in equity value (market capitalisation) on the day of announcement (day 0) to equity value on day +1.

Dilution (%)	Number of Firms	Average Dilution in the Range	Cumulative (%)
0 <	19	6.23	6.23
(-10) < ≤ 0	27	-1.30	4.93
(-20) < ≤ (-10)	1	-10.19	-5.26
(-30) < ≤ (-20)	0	0.00	-5.26
(-40) < ≤ (-30)	0	0.00	-5.26
(-50) < ≤ (-40)	0	0.00	-5.26
(-60) < ≤ (-50)	0	0.00	-5.26
(-70) < ≤ (-60)	0	0.00	-5.26
(-80) < ≤ (-70)	0	0.00	-5.26
(-90) < ≤ (-80)	0	0.00	-5.26
(-100) < ≤ (-90)	0	0.00	-5.26
TOTAL	**47**		
Average Offering Dilution	0.00866 (0.86600%)		
Median (%)	0.00		
Maximum (%)	25.00		
Minimum (%)	-22.83		

CONCLUSION

Even though our initial expectation was that there would be a substantial difference in the way warrant issuing companies perform following the same procedures as in common stock cases, those results report similarly to our estimations. In the stock price reaction, there is a negative response of warrant issuing SEO firms on the announcement date. This is consistent with our previous study on common stock offering firms in Thailand (see Lerskullawat, 2012). However, our evidence indicates that offering dilution leads to differences in the outcomes between SEO warrant issuing firms and those issuing via common stocks. Thus, issuing new shares via warrants appears to be less risky compared with non-warrant issuing (total sample), and reduces the offering dilution.

For more in-depth analysis, we intend to examine the post-issuing performance of these warrant SEO firms. Several studies (e.g. Spiess and Affleck-Graves, 1995; Barber and Lyon, 1997; Hertzel et al., 2002; Kothari and Warner, 2006) suggest variety of methodology for measuring the post-issued SEOs' performance. The popular methodologies, such as the Buy-and-Hold Return (BHR) approach, will be considered first for application in our investigations.

REFERENCES

1. Aktas, N., De Bodt, E. and Cousin, J.-G. (2007) Event studies with a contaminated estimation period. **Journal of Corporate Finance**, 13 (1): 129-145
2. Asquith, P. and Mullins, D. W. (1986) Equity issues and offering dilution. **Journal of Financial Economics**, 15 (1-2): 61-89
3. Barber, B. M. and Lyon, J. D. (1997a) Detecting long-run abnormal stock returns: The empirical power and specification of test statistics. **Journal of Financial Economics**, 43 (3): 341-372
4. Bartholdy, J., Olson, D. and Peare, P. (2005) **Conducting event studies on a small stock exchange**. Working paper, Social Science Research Network.
5. Billingsley, R. S. and Smith, D. M. (1996) Why do firms issue convertible debt? **Financial Management**, 25: 93 – 99
6. Brick, I. E., Palmon, O. and Patro, D. K. (2004) **Stock price response to calls of convertible bonds: still a puzzle.** Working paper, Social Science Research Network
7. Brooks, C. (2008) **Introductory econometrics for finance**, Cambridge: Cambridge University Press.
8. Brown, P. R., Lee, M., Owen, S. A. and Walter, T.S. (2009) **Corporate governance and the long-run performance of firms issuing seasoned equity: An Australian study**. Working paper, Social Science Research Network.
9. Chemmanur, T. J. and Fulghieri, P. (1997) Why include warrants in new equity issues? A theory of unit IPOs. **Journal of Financial and Quantitative Analysis,** 32 (1): 1-24.
10. D'Mello, R., Tawatnuntachai, O. and Yaman, D. (2003) Does the sequence of seasoned equity offerings matter? **Financial Management**, 32 (4): 59-86
11. Dunbar, C. G. (1995) The use of warrants as underwriter compensation in initial public offerings. **Journal of Financial Economics**, 38: 59-78
12. Eckbo, B. E., Masulis, R. W. and Norli, Ø. (2006) **Security offerings**. Working paper, Social Science Research Network

13. Eckbo, B. E., Masulis, R. W. and Norli, Ø. (2000) Seasoned public offerings: Resolution of the new issues puzzle. **Journal of Financial Economics**, 56 (2): 251-291
14. Ederington, L. H. and Goh, J. C. (2001) Is a convertible bond call really bad news? **The Journal of Business**, 74 (3): 459-476.
15. Elton, E.J., Gruber, M.J., Brown, S.J. and Goetzmann, W. N. (2003) **Modern portfolio theory and investment analysis (6th Ed.),** New York: Wiley
16. Gajewski, J.F. and Ginglinger, E. (2002) Seasoned equity issues in a closely held market: Evidence from France. **European Finance Review**, 6 (3): 291 – 319
17. Hertzel, M., Lemmon, M., Linck, J. S. and Rees, L. (2002) Long-run performance following private placements of equity. **Journal of Finance**, 57 (6): 2595-2617
18. Jirasetthakulchai, M. (2000) **The study of dividend announcements and seasoned equity offerings in the stock exchange of Thailand**. Master's dissertation, Chulalongkorn University
19. Korkeamaki, T. P. and Moore, W. T. (2004) Convertible bond design and capital investment: the role of call provisions. **Journal of Finance**, 59 (1), 391-405
20. Lerskullawat, P. (2012) **Seasoned equity offering in an emerging market: evidence from Thailand**, Lap Lambert Academic Publishing GmbH & Co., Saarbrucken, Germany
21. Lertsupongkit, P. (2002) The **Thai stock market's reaction to equity offering announcements.** Master's dissertation (Finance), Thammasat University
22. Lewis, C. M., Rogalski, R. J. and Seward, J. K. (1998) Agency problems, information asymmetries and convertible debt security design. **Journal of Financial Intermediation**, 7: 32-59
23. Lewis, C. M., Rogalski, R. J. and Seward, J. K. (2001) The long-run performance of firms that issue convertible debt: an empirical analysis of operating characteristics and analyst forecasts. **Journal of Corporate Finance**, 7 (4): 447-474
24. Mackinlay, A. C. (1997) Event studies in economics and finance. **Journal of Economic Literature**, 35 (1): 13-39
25. Mann, S. V., Moore, W. T. and Ramanlal, P. (1999) Timing of convertible debt issues. **Journal of Business Research**, 45 (1): 101-105
26. Marisetty, V. B., Marsden, A. and Veeraraghavan, M. (2008) Price reaction to rights issues in the Indian capital market. **Pacific-Basin Finance Journal**, 16 (3): 316-340
27. Mayers, D. (1998) Why firms issue convertible bonds: The matching of financial and real investment options. **Journal of Financial Economics**, 47 (1)**:** 83-102
28. Mishra, A. K. (2007) The market reaction to stock splits: Evidence from India**. International Journal of Theoretical & Applied Finance**, 10 (2): 251-271
29. Ng, C. K. and Smith, R. L. (1996) Determinants of contract choice: The use of warrants to compensate underwriters of seasoned equity issues. **Journal of Finance**, 51 (1): 363-380
30. Prangthawat, W. (2002) **Earning management and the performance of seasoned equity offerings: Evidence from the stock exchange of Thailand**. Master's dissertation, Chulalongkorn University
31. Salamudin, N., Ariff, M. and Nassir, M.D. (1999) Economic influence on rights issue announcement behavior in Malaysia. **Pacific-Basin Finance Journal,** 7: 405-427
32. Seiler, M. J. (2004) Chapter 13: Event studies in **Performing financial studies – a methodological cookbook**. Upper Saddle River, N.J. Pearson/Prentice Hall
33. Singh, A. K., Cowan, A. R. and Nayar, N. (1991) Underwritten calls of convertible bonds. **Journal of Financial Economics**, 29 (1): 173-196

34. Teoh, S. H., Welch, I. and Wong, T. J. (1998b) Earnings management and the underperformance of seasoned equity offerings. **Journal of Financial Economics**, 50 (1): 63-99
35. Vithessonthi, C. (2008) What explains stock market reactions to proposals to increase the authorized common stock? **Journal of International Finance and Economics**, 8 (1): 126-136
36. Walker, M. D. and Yost, K. (2007) **Seasoned equity offerings: What firms say, do, and how the market reacts?** Working paper, Social Science Research Network

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

BUSINESS JUSTIFICATIONS FOR RAPID PRODUCTISATION IN SMALL- AND MEDIUM -SIZED COMPANIES

Kai Hänninen, Department of Industrial Engineering and Management, University of Oulu, Finland
Email: kai.hanninen@oulu.fi

Matti Muhos, Oulu Southern Institute, University of Oulu, Finland
Email: matti.muhos@oulu.fi

Harri Haapasalo, Department of Industrial Engineering and Management, University of Oulu, Finland
Email: harri.haapasalo@oulu.fi

ABSTRACT

Purpose: *Rapid productisation (RP) is a new concept originating from practical challenges. RP is a process of quickly supplementing a company's product or service offering to meet unexpected customer needs. The objective of this study is to describe how an RP is used and experienced in small- and medium-sized companies (SMEs) and how the use of RP is justified in SMEs located in North America.*
Methodology: *This holistic multiple case study opens the RP concept by clarification of business case objectives set to start RP, analysis of RP challenges, and description of business justifications used for RP in the case of SMEs.*
Findings: *This study provides an introduction to the RP practises of the case companies and describes the main objectives for RP, the key challenges faced, and a deeper analysis of the business justifications used for RP. As a rule of thumb, RP is justified if it creates new business.*
Research limitations: *RP is a new concept and is not widely used. This was a clear challenge during the study. The interviewees mainly viewed RP as a more rapid way to execute the normal productisation process, resulting in time savings.*
Practical implications: *This multiple case functions as a benchmark for SME managers, intermediaries, and researchers. Our findings provide support for the managers of SMEs considering RP as one option in revenue making.*
Originality: *RP is a new concept originating from practical challenges and requires closer attention from the academic community. The academic community can provide fresh perspectives to new product development.*
Classification: *Case study*

Keywords: Rapid productisation, justification, business case, decision making, small-and medium-sized enterprises.

INTRODUCTION

Product development can be defined as the transformation of a market opportunity into a product available for sale (Krishnan and Ulrich, 2001). This is often considered as a long process with multiple checkpoints (e.g. Cooper, 2001). Based on an extensive literature review, Krishnan and Ulrich (2001) organised product development decisions into two broad categories: (1) decisions within a development project (including concept development, supply chain design, product design, and production ramp-up and launch) and (2) decisions in setting up a development project (including product strategy and planning, product development organisation, and project management). These categories of decisions are applicable to rapid productisation (RP); however, time is a critical factor in RP, and many of the methods used for decision making in the traditional product development process do not apply or need to be simplified. This study addresses decision making in setting up a development project. In particular, we focus on decisions related to business justifications of RP in small- and medium -sized companies (SMEs).

SMEs are often associated with a country's higher economic growth (Reynolds, 1997; Robson and Bennett, 2000). Beck et al. (2005) studied the relationship between the size of the SME sector and economic growth in 45 countries. They found that the share of SME employment in total manufacturing employment is associated with a higher rate of gross domestic product (GDP) per capita growth. Ayyagari et al. (2007) analysed the relationship between the relative size of the SME sector to total employment in manufacturing and GDP across 76 countries. By presenting comprehensive statistics utilising a cut-off of 250 employees, they showed that on average in these countries, the SMEs' contribution to the labour force constitutes 54% of the economy. The impact of SMEs on employment is therefore globally significant.

On one hand, SMEs are an important and integral part of every country's economy, the fastest growing sector of many economies, more flexible and adaptable in terms of structure, and having a faster speed of response than larger organizations. (Tagliavini *et al.,* 2001). In particular, the existence of a large SME sector does not directly cause economic growth but should be considered as one characteristic of a successful economy. On the other hand, SMEs typically have fewer financial resources, lower technical expertise, and more limited management skills than large companies (Blili and Raymond, 1993). These limitations affect decision making related to product development and productisation in the broader sense.

The term *small- and medium-sized enterprise* varies in meaning depending on context. In the US context, for example, the meaning of SME depends on the industry. In some industries, an SME is a company having less than 500 employees. In Europe, the SME is defined as a company having less than 250 employees. This variance needs to be taken into account when analysing SME-related literature. Ayyagari et al. (2007) covered this topic in a globally focused statistical study on SMEs:

> The term SME covers a wide range of definitions and measures, varying from country to country and varying between sources reporting SME statistics. Some of the commonly used criteria are the number of employees, total net assets, sales, and investment level. However, the most common basis for definition is employment, and here again, there is variation in defining the upper and lower size limit of an SME.

> Despite this variance a large number of sources define an SME to have a cut-off of 250 employees (Ayyagari *et al.,* 2007 p. 416).

In our study, we use the European definition. Within the SME category, the European Union defines medium-sized firms as having 50–249 employees, small firms as having 10–49 employees, and micro-firms as having 1–9 employees (Storey, 2003).

Innovation plays a key role in the long-term success for many companies. Customer-oriented companies are constantly challenged by the markets to keep their offering timely and responsive to the customer needs (Alam, 2002). Respectively, new service and new product development have been widely studied disciplines in academic research during the last three decades (Johne and Storey, 1998; Trott, 2002).

In many businesses the final offering is agreed in sales negotiations with the customer. Usually the product is created with a sales configuration tool or is bundled from a predefined set of components (Hvam *et al.,* 2008). Obviously a sales negotiation can lead to a situation where the customer's demands cannot be fulfilled. This usually ends the sales negotiations and the customer leaves without a deal. According to Jaakkola (2011), RP refers to those practices necessary to rapidly generate a manageable and exchangeable service offering. Little research has been carried out in the rapid response to customer requirements during the sales contact by complementing or altering the offering. Many managers and practitioners in SMEs have indicated that this kind of "rapid productisation" is a common but informal and disorganized process in practice. In addition, better management of the process would be beneficial.

Building a proper business case is key to successful decision making related to RP. Multiple methods are offered for the analysis of the business case in traditional product development; however, many of the proposed tools are too complex to be effectively used in a sales situation where decision making needs to be fast. Kinnunen et al. (2011) stated that a business case is for analysing ideas that come through a company's new product development (NPD) process to commit NPD resources to the right projects. The actions for building the traditional business case often include analysis of user needs, competitive analysis, market analysis, technical assessment, concept testing, financial/business analysis, and action plans (Cooper, 2001). Reviewing the details of user needs and analysis (including, e.g., in-depth market research) would take too much time in the sales negotiations and in the time frame available for RP, which requires more flexible and agile methods for business analysis. Moreover, a proper business case to justify an investment should include a business and economic rationale for the investment, a definition of the investment and its feasibility, a financial model quantifying and valuing the benefits and costs of the investment, and a plan for delivering business and financial value (BCP, 2006). It is not clear how these goals can be met in the sales situation as is often necessary for RP.

The aim of this study is to define business justifications for RP and to provide practical guidelines for managers of small business. The research questions of this study are as follows:

RQ1: *What are the business case objectives to start RP?*
RQ2: *What are the RP challenges of companies?*
RQ3: *What are the justifications for RP?*

The concept for productisation used in this study has been aligned from the case companies and provides a frame for analysis. Cases are described in detail using a framework for structuring empirical data. Our research questions evolved from the practical challenges faced by both the case company and the industry in general and are considered to be relevant for any organization interested in RP.

METHODS

This retrospective multiple case study uses a holistic research strategy (Saunders *et al.,* 2007; Yin, 2003). We divided the research process into three phases: case study design, single-case data collection, and analysis and cross-case analysis (Figure 1).

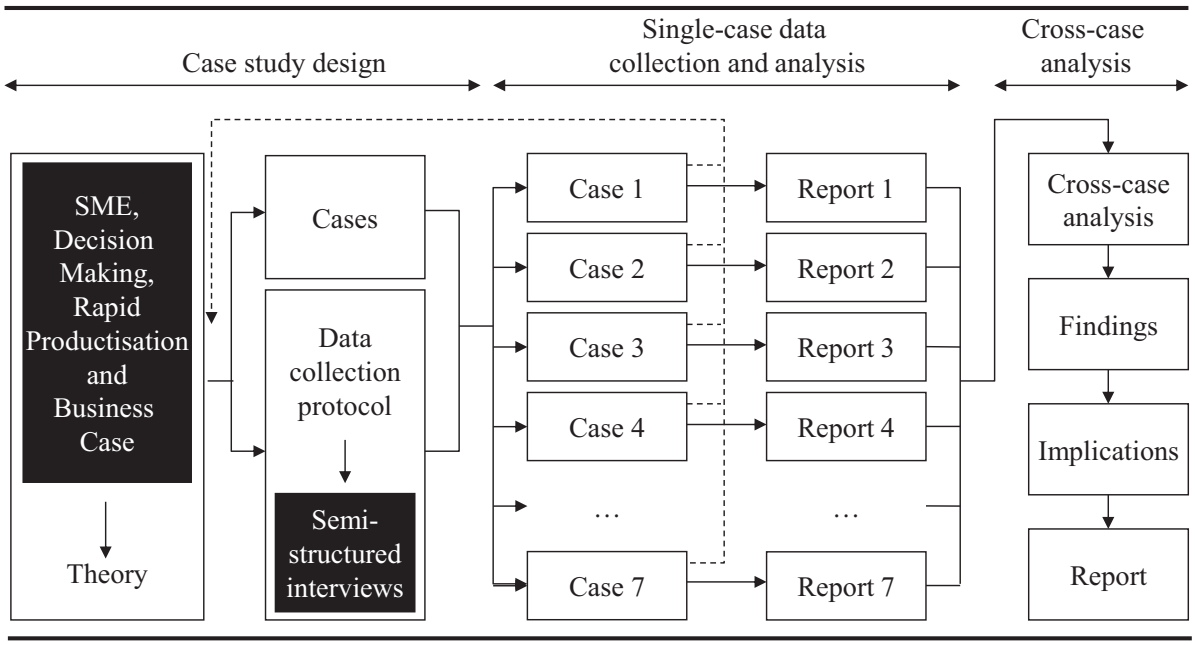


Figure 1. The research process

Qualitative research refers to any type of research that produces findings that are not results of statistical or other means of quantification (Corbin and Strauss, 2007). However, multiple data collection techniques can be employed in case studies and are likely to be used in combination with one another (Saunders *et al.,* 2007, p. 139). Moreover, both qualitative and quantitative evidence can be shown in a case study (Yin, 2003); in fact, Yin (2003) encouraged using both techniques. In line with Yin's (2003) guidelines, we collected a combination of qualitative and quantitative evidence, with the main focus on qualitative analysis. At the data collection phase, qualitative techniques may include focus groups, individual depth interviews, and case studies (Cooper and Schindler, 2010). During analyses, the qualitative researcher often uses the content analysis of written or recorded materials. Qualitative research aims at providing an in-depth understanding about the situation in hand (Cooper and Schindler, 2010).

The data was drawn from semi-structured interviews designed to gather information about the upstream supply chain in rapid productisation in US industries. Interviews were constructed to allow the interviewees to explain and clarify the case and topics as entities. Interviews

were conducted in seven heterogeneous companies to obtain a wider view on the subject studied (Table 1). These companies were able to provide comprehensive study material and the extent of the phenomenon of RP.

The companies' advanced practices and advanced product development processes can be used to compare other participating companies. The topics that were company specific are not reported. Altogether, the study included 11 interviews (Table 2). The interviewed industry experts were carefully selected based on their professional background and expertise. The selected participants hold positions related to productisation. Their experience and current interest ensured high motivation and relevant knowledge about the topics discussed. The questionnaire was sent early enough to enable the interviewees to review it in advance. The interviews were recorded and transcribed and lasted up to 2 hours each.

NVivo®, QSR International Pty Ltd, Australia made software was used in organizing and analysing the interview content and for criteria categorization. For each company, we conducted a within-case analysis and classified the cases according to the following categories: RP, business case for RP, and RP challenges. Company characteristics are presented in Table 1.

Table 1. Case company characteristics

Case	No. of interviews	Role of the interviewee	Area of business
A	1	CEO	Electronics manufacturing
B	1	CEO	Software solutions and equipment manufacturing
C	1	CEO	Telecommunication
D	2	CEO and Director of Marketing	Software solutions and consumer goods
E	2	CEO and Manager of Product Development	Software solutions
F	2	CEO and President of Sales/Marketing	Software solutions
G	2	CEO and Bio Technology Consultant	Biotechnology

RESULTS

The study was carried out in a multiple case study that incorporated electronics manufacturing to biotechnology SME companies located in North America. The companies are referred to as A, B, C, D, E, F, and G (Table 2).

Table 2. Case company information

Case	Founded	No. of employees	Current total sales ($ Milj.)	Current value of assets ($ Milj.)
A	1971	37	12.00	10.00
B	1995	30	5.70	2.50
C	1999	25	sensitive	sensitive
D	2009	18	2.00	6.00
E	2003	15	0.50	0. 39
F	2009	11	1.30	2.90
G	2009	7	0.10	4.50

Rapid Productisation

Company **A**, an electronics manufacturing company located in Washington, aims to minimise interference with the standard product by using the same housing, plugs, or connectors. The benefit is that the company can optimise its ability to buy parts in volume, although perhaps at a lower volume, based on the business case. The project manager plays a key role during the RP process and is very involved throughout the process rather than a commodity salesperson that looks for a customer, takes an order, and moves on. RP also requires a more involved sales and purchase integration process. The drawback is the company needs to have more people internally, which would then change its structure from being 'lean and mean'.

Company **B** is a software solutions and equipment manufacturer located in California. A need for RP with a request to change the product roadmap pops up regularly when the research and development (R&D) section is working on a new product development case. One reason why there are so many new requirements coming from customers is that company B is in a relatively early developmental stage. The product roadmap released to the market may have a reduced functional subset and does not fully satisfy customers, which is why customers return to the company for a specific derivation. The company needs to make a decision whether to rapidly develop and productise a solution for the customer or put it into a proposal for future development. Company B tries to avoid developing a solution for only one customer. RP requires an extra effort because usually the solution needs to fit into the long-term strategy for the company. By doing RP lower level of investment might reduce the development cost to that of NPD, but might not necessarily be less.

Company **C**, a telecommunications company located in Maryland, has been incorporating RP for several years, and this causes challenges in the sales situation. Company C's business is as a small-volume, highly customised industry. RP enables the company to be predictable and to give the customer proper feedback. Historically, if the customer was willing to buy, the company was willing to invent it, and this is how the company developed its product line. Currently the company's product line offers better conditions, and the company has done sufficient development to ensure the product line can satisfy most customers immediately. The company is now shifting towards stronger prioritisation in product development and are examining whether there are other sales opportunities.

Company **D** is a software solutions and consumer goods company located in California. Sales face a need for RP basically every week. The situation is challenging to sales, and employees

probably do not manage it as well as they should. First, many customers ask for the same things. In these situations the sales group is able to provide a response because the company is familiar with the question. From the interview:

> *"I think if you do your work upfront and you need to make self-question does it fit* into *our business model. Are the bulk of the customers wanting it or willing to commit to buying it? And then, what's the longevity of the product? Is it a one-time product or is it something that can be offered over and over and over through time? You reduce a lot of your challenges and your risks because you've done your work upfront, which doesn't take that much time, in an effort to better ensure success".*

However, for a new request where RP is required, they really cannot give a reliable response for at least three reasons: in a typical sales–engineering relationship, sales tend to overpromise and engineering subsequently under delivers. It endangers the business when sales overpromise deadlines and promise certain customers that they can skip a line. From a sales' perspective, it is all about understanding the customer's thoughts and the company's business. Usually the sales person just goes to the marketing team and asks for these new features. In the case where the feature is necessary, it gets advanced on a schedule and other things are moved down; however, if it is a feature that is nice but not essential, it is placed on the wish list.

Company **E** is a software solutions company located in California. The company has not had a single customer that is has paid to build one particular product. Instead they have multiple customers who are interested in similar things. If RP is used for one customer, it requires customer integration on the company's sales cycle. Even when produced initially for one customer, a product should be useable by other customers. It is typical that a customer is interested in the standard product but wants to see a proof of concept application in the demo that requires the company to build a fast add-on. To do this requires a live demonstration in a configuration using data the customer is interested in. The decision to do or not to do RP depends on the amount of work needed. Sales have an important role and have to define and describe what it is the customer is asking for. From the interview:

> *"Because sales is always spinning around different crazy stuff development has to stay focused and disciplined to get things done, otherwise they'd be moving around and they'd never finish".*

It is important that a definition of scope is very clear in the case of RP. In the business culture, the sales staff have to be sure they are dealing with people that have the authority to make the decisions. It is important that a customer knows what they want. When the company has a good team to work with and the team has a good dialogue with the customer, it is very constructive, making it safe for the company to do RP.

Company **F**, a software solutions company located in California, historically did more RP. Its situation has changed, and currently the company gets more requests for its products, which are equal to market standards and getting more advanced. When the company first started operating, it often needed to provide RP to win clients, but now RP is used more as an enhancement. The company seeks to increase agility just by constantly adding features. A basic software release cycle is 1 to 2 weeks, and the company has a 60- to 90-day release cycle once a year to develop effort-intensive functionality. An ability to balance the work load of development is crucial. It is not good for business if all on-going development needs

to stop to address an RP; this happened once and everything else was delayed by 6 weeks. Company F is going to change that in the future. The company's target is to save part of the business for RP and the rest of the business for its core direction.

Company **G**, a biotechnology company located in California, was interviewed at the time when RP was needed. The company has the ability to deviate from their platform portfolio, and this has been done several times. From the company's perspective, it is important to meet the needs of customers and it is something the company is able to do. From the interview regarding how to be agile:

> *"You know nothing big, fancy, no 10,000 dollar market research studies, just an airplane trip to Atlanta to meet people over a cup of coffee."*

Making fast decisions and quickly developing a new business plan are things that small companies can usually do better than large companies. A request from a customer for an RP in sales is a common topic and in many cases RP can be done. The company has received more and more product portfolio-related questions "...*can you have that or this*…", and this has been a recurring event over the past 2 years. It a clear indication for RP and highlights the missing part in a company's normal offering. The sales situation is all about listening to a customer and then reprioritising the requests. In a small company like G, one of the key management responsibilities is to constantly evaluate how much effort an RP requires versus other development—balancing on-going work and at the same time maintaining opportunities to have flexibility with RP. Management needs to ensure that development is not stuck and prioritisation is constantly being re-evaluated.

Business Case Objectives for Rapid Productisation

In *Company* **A**, the basic business purpose is to make a profit. The company makes money by making products and thus do not sell engineering time. Business justifications for RP are to build a product that will sell and either make a large profit or potentially develop a new market. The justification for building a new design is to be a stepping stone to something else. If the customer preferences can be met, the company can justify a marginal fiscal performance on their first orders because they assume it will attract future customers, which could then place the company in a new market or give the company something new to develop in the long term. Company A is always looking for something new.

Company **B**, as an early stage company, views the ability of a customer to pay to enhance their product in a way that the company would eventually do, as optimum. A core business case for RP is having a better product that will grow the company in the future. This is an incredibly strong driver for doing RP even if it is disruptive to the organisation in the short term. When a customer inserts itself into the RP process by having a short-term need that drives revenue, the company tends to be responsive because from the company's perspective, R&D will be free. This is important. At present, it not only helps Company B to accelerate revenue but also helps accelerate product development, which is a win–win–win situation—a win for sales, for product development, and for the end customer who gets something that is needed.

In *Company* **C**, the Chief Financial Officer would prefer a world where there are always customer requirements, customer orders, and the engineer is only working on something that

the customer is willing to pay for. In the early years of Company C, this was not the case. The main reason to start RP is a business case that will guarantee enough sales, feasible technology to justify an engineering effort, and appropriate prioritisation. RP is a qualitative weighing of nonrecurring engineering effort versus potential sales.

In *Company* **D**, RP should fit a business strategy. Company service builds on the affinity of their buying network. The network can been seen as a scalable layer that accelerates business. RP has to meet financial goals and be profitable. Simply, the company needs to be able to make a profit from RP. The business case for RP will be met when a new product incrementally increases sales and not just splits sales.

In *Company* **E**, the business cases to start RP are: a reasonable scope, no technical risk to build a product, resources will be available, doable schedule, and the promise given to the customer can be met. Company E is small, and one of the problems with RP is the need to maximise an opportunity cost. When the work has been done, it is essential to leverage effort into a new product line or complement the product line the company is already investing in. To keep it simple, if there is a customer willing to purchase the product, the best business case the company can get is being able to sell the product.

There are two business cases for RP in *Company* **F**. The first is what the revenue for a client is and this has to be more than $10,000 per year. The second is the question, is it a solution that the company can apply to all their other clients as well to make a greater profit? The main target from RP is to get something for a product portfolio and something that the company can universally use for all their clients. Otherwise, the company tells customers they need to find a third-party developer. The client has to have available resources and must be dedicated to a successful program once the company has built the product.

Company **G** has no formal processes because the company and its market are relative small. The company uses unformed processes and relies on market forecasts. The company likes to keep things simple. The business case for RP is a positive return on investment. The business case to start RP requires that there are enough sales, feasible technology to justify an engineering effort, and it is prioritised appropriately. Small companies need their revenue sooner rather than later. The company has to survive on RP development because it generally does not have three or four projects that are on-going.

Rapid Productisation Challenges

When using RP, *Company* **A** tries to find a product that fits a wider market. RP cannot be used to build a totally new product. As an example, total product development time for a tactical communications product ranges from 12 months to 14 months. One version of the product range is the way the company can make the best profit. If there is a need to make 14 versions of the product and to sell it to 14 different clients, there are risks that the package or features will not be set correctly. If use of RP requires third-party vendors, it is essential to know the person the company is going to deal with. From an interview with a purchase manager about the CEO's response to possible vendor use: *'Oh, I don't want to use that vendor because they will be a risk for us. Can't you use anybody else?'*

Company **B** is working on a software as a service model. They would not do RP just for revenue but want the visibility that comes with enhancing a product. Upstream supply chain management needs extra attention. From an interview:

> *"Upstream supply chain is typically less able to respond than we are, and they are typically less motivated to respond than we are. And that has to do with I think the whole small versus large company thing because we are typically sourcing from larger companies than ourselves".*

If a customer really wants something that is going to impact the experience of the rest of the user community, it obviously carries much more expense from development. One-off or bespoke services is different. When the company does RP, it is a disruption, which is why a product should support the customer, make it better overall, and leave no negative impact to the customer experience. Parallel RP and NDP is difficult for a relatively small company.

For *Company* **C** the main reasons not to do RP are mainly related to different technically feasible challenges or capacity shortage in the product line, even when the customer is willing to buy a product. One solution to solve capacity shortage is outsourcing resources. From an interview:

> *"...we have in fact done some of that in the past when we're just really busy. It's a way to add bandwidth without having to add to the payroll".*

In *Company* **D**, the cost of developing is prohibitive and starts to impact the company's regular business. They have to take people off from developing and selling to do on-going projects. At the moment the company does not have enough manpower to support RP. If there are five things a customer wants facts for, three of them are ones that the company can do well. The other two customers requests will be put on the list for future development.

Company **E** can earn acceptable profits from RP in terms of pricing and profitability. Problems occur if the products are just one-off instead of products that the company can sell to a number of customers. RP in the company's market place requires having a lot of employees, which is the main reason the company is not able to do many one-off products.

Company **F** will never build anything that only one client would own. There is also the need to have them 'right client' for RP. From the interview:

> *"Some of our clients will pick bad developers and they screw things up. And they'll pay us to fix them".*

The client should also have existing customers available for the product.

The main limiting factor for RP in *Company* **G** is how to set correct priorities to manage development. From the development perspective, RP requires that everything goes smoothly. When problems occur, these have to be solved fast. RP is not a typical research project.

ANALYSIS AND DISCUSSION

As a result of this study, the justification for RP in the case companies was described based on the interview data. The interviewed case companies commonly ended up either spinning off a new product or enhancing the existing product based on a customer's needs. When there is the need to modify products to meet only one customer's requirements, there has to be a

revenue opportunity, which requires that the product functionality later becomes a part of the product/service portfolio available for other customers. Portfolio management practises should be in use to support RP. A formal process for reviewing and handling customer's requests received from RP is essential. A summary of RP is presented in Table 3.

Table 3. Summary of rapid productisation

Role of sales (salesperson) is critical
Way to resolve situation when current product roadmap does not satisfy customer
Challenge situation in sales and important that the customers know what they want
Way to win clients and meet needs of customers
Sales and R&D integration
Used more in company's early stage phase
Target to have a portfolio-wide solution not a single customer
Could be needed basically every day
Requires ability to make fast decisions and prioritisation re-evaluation
Quick development of new business plan
Right balance between RP, core business, and effort

As an answer to RQ1, before starting RP a company needs to do more market research and not just react to something that sounds good. Before creating something, a company wants to be able to leverage it across the entire platform. According to interviewees, the basic financial justification of an RP project is based on evaluated income from the project. However, situations where this is not the case were mentioned. For example, an actual feature has already been promised or the deal is somehow secure if the customer requirement can be met. One interviewee even mentioned that some projects are justified primarily based on intuitive decisions about profitability. It was also pointed out that these projects must have full support from top management. Table 4 summaries the objectives for the RP business case.

Table 4. Objectives for RP business cases

Build a sellable product to make money
Reach new markets or product segments
Core for long-term development and growth of business in near future
Accelerates product development
Prioritisation can be made without compromising the existing roadmap
Fits a business strategy and supported by management
Business opportunity upsurge for financial goals and revenue
Incrementally grows sales and not just splits sales
Promise given to the customer can be met

To address RQ2, a sudden need for RP in sales is a challenging task for sales people. It endangers the business if sales overpromise deadlines and promise certain customers that they can skip a line without better knowledge of what is needed. Challenge areas for RP from management are: 1) a relationship between sales and engineering, 2) sales not overpromises and/or overestimates requirements, and 3) engineering will not under deliver. Sales has to ensure they are dealing with people that have the authority to make the decisions. It is

important that a customer knows what he or she wants. It is best when a customer has some technical knowledge in an area under sales negotiations.

When RP is targeted to more than one customer it will require an extra effort because the solution needs to fit into the longer term strategy for the company. An essential issue for RP is that sales, development, and management know how the customer's request for the product/service fits within the objectives and scope of the company's strategy. Table 5 summaries the RP challenges of the case companies.

Table 5. Summary of rapid productisation challenges

Fit for wider markets and product portfolio compatibility
Not for totally new products or use of new technology
Prioritisation between RP and NPD
One-off products could increase unnecessary product variety
Upstream supply chain and third-party vendor management

To address RQ3, the business is not feasible if all on-going development needs to stop for tackling RP. This happened with one case company and other work was delayed for 6 weeks. The company is going to change this in the future. The company target will be save part of the business for RP and the rest of the business for the core direction. Are the financial benefits so big that the project is worth doing even if partner companies must be used? Is the project a possible entry to a new customer segment or market area or even a new single customer that is big enough? One key point to address is also whether the project would help the company in differentiation from competitors. The company should also be able to test the solutions early on. RP is justified if it creates new business. The analysis is always made beforehand based on the business justifications and resources the company has available. Justifications for RP are presented in Table 6.

Table 6. Justifications for rapid productisation

A reasonable scope and line with company strategy
No technical risk to build a product or service
Resources and needed knowledge are available
Doable schedule and promise given to the customer can be kept
Work is added with equal revenue
As a company grows and matures, each new sale is not as important
A new product will incrementally grow sales and not just split sales

CONCLUSIONS

It is essential when using RP that the RP process is dynamic and all advantages of existing frameworks are fully integrated. Responsibilities between sales and R&D need to be clear. After starting RP, conversations between sales and R&D need to be smooth and objective. In the company everyone should be on the same page. Well-executed portfolio management in cooperation with RP is one way to minimise unnecessary growth of product variety.

Use of third-party vendors to support a resource shortage need to carefully examined because vendors could be less motivated to respond and it might cause challenges in a later phase. Being able to keep a promise given to customers is a must for RP. Company has the ability to lose the trust of a customer only once.

Using RP does not mean that product development costs are automatically small. Cost of development might be the same as NPD and not necessarily be less. RP requires sufficient sales potential and should be technologically feasible. It must be able to justify the engineering effort and be able to prioritise appropriately. RP is a qualitative weighing of nonrecurring engineering effort versus potential sales.

Managerial implications

One proposal for how management could solve the challenge in sales negotiations is to explain to sales people where the company's market is compared to the full market place. Sales should increasingly look at not just whether there is one sale but could there be several sales opportunities.

Has the company capacity to spare for the project? In small companies one of the key things management needs to do is constantly evaluate how much effort could be put to RP versus other development (i.e., NPD). Management needs to balance on-going work and at the same time maintain flexibility for RP opportunities. Management needs to ensure that development is not stuck and prioritisation is being re-evaluated.

Limitations

This study has focused on small business use of RP. Addressing some of the limitations of this study should stimulate further research. First, the number of interviewed companies is limited; a deeper analysis is needed to broadly cover the studied topic. Secondly, our study focuses on small companies. The next step would be to study what might be justifications for RP in large companies. Third, it would be interesting to examine in more depth how new companies can utilise and take advantage of RP to boost companies' early growth.

REFERENCES

1. Ayyagari, M., Beck, T., and Demirguc-Kunt, A. (2007), "Small and medium enterprises across the globe ", *Small Business Economics*, Vol. 29 No. 4, pp. 415-434.
2. BCP. (2006), *The business case checklist*, Business Case Pro, Lexington, KY, USA
3. Beck, T., Demirguc-Kunt, A., and Levine, R. (2005), "SMEs, growth, and poverty: cross-country evidencet", *Journal of Economic Growth*, Vol. 10 No. 3, pp. 199-229.
4. Blili, S., and Raymond, L. (1993), "Information technology: threats and opportunities for small and medium-sized enterprises", *Internal Journal of Information Management*, Vol. 13 No. 6, pp. 439-448.
5. Cooper, D., and Schindler, P. (2010), *Business Research Methods*, Irwin, McGraw-Hill.
6. Cooper, R.G., (2001), *Winning at new products: Accelerating the Process from Idea to Launch,* 3rd ed., Perseus Publishing, Cambridge, MS, USA.
7. Corbin, J., and Strauss, A. (2007), *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*, 3rd ed., SAGE Publications, Inc.

8. Kinnunen, T., Pekuri, A., Haapasalo, H., and Kuvaja, P. (2011), "Business case analysis in new product development", *Global Journal of Management And Business Research*, Vol.11 No. 2.
9. Krishnan, V., and Ulrich, K. (2001) "Product development decisions: A review of the literature", *Management Science*, Vol 47 No 1, pp. 1-21.
10. Reynolds, P.D. (1997), "New and small firms in expanding markets", *Small Business Economics,* Vol. 9 No. 1, pp. 79-84.
11. Robson, P.J.A. and Bennett, R.J. (2000), "SME Growth: The Relationship with Business Advice and External Collaboration", *Small Business Economics*, Vol. 15 No. 3, pp. 193-208.
12. Saunders, M., Lewis, P., and Thornhill, A. (2007), *Research Methods for Business Students*, Financial Times/Prentice Hall, London.
13. Storey, D.J. (2003), *Entrepreneurship, Small and Medium Sized Enterprises and Public Policy*. In: Acs ZJ and Audretsch DB (eds), Handbook of Entrepreneurship Research. Dordrecht, International Handbook of Entrepreneurship Research, pp. 473-511.
14. Tagliavini, M., Ravarini, A., and Antonelli, A. (2001), "An evaluation model for electronic commerce activities within SMEs", *Information Technology and Management*, Vol. 2 No. 2, pp. 211-230.
15. Yin, R.K. (2003), *Case Study Research: Design and Methods*, 3rd ed., Beverly Hills, Sage Publications.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

INSTITUTIONAL ARRANGEMENT, TECHNOLOGICAL INNOVATION AND APPLICATION EVOLUTION: THE RISE OF CHINA'S EMERGING COMPUTING INFRASTRUCTURE

Jiang Yu, Institute of Policy and Management, Chinese Academy of Sciences
No. 15, Zhonguancun Beiyitiao, Beijing, 100190, P.R. China
Email: yujiang@mail.casipm.ac.cn, Telephone: 0086 10 59358509

Yue Zhang, Institute of Policy and Management, Chinese Academy of Sciences
No. 15, Zhonguancun Beiyitiao, Beijing, 100190, P.R. China
Email: zhangyue0650037@163.com

ABSTRACT

This paper tries to explore the interaction of institutional arrangement, technological innovation and application evolution underlying the impressive growth of China's computing infrastructure. Drawing upon the actor-network theory, we construct a framework to explain how the elements identified forge the evolution of the sector. Our study hopes to provide the analytical lens and explanatory power to probe this growth process under the emerging contexts. We conduct an in-depth case study on the growth of China's emerging computing infrastructure to justify the framework. Chinese government has been deeply involved in the development of the computing infrastructures including the systems of supercomputing and cloud computing to build a nationwide computing backbone network. In the resent emerging of cloud computing, the networks which involved in much more diversified actors with heterogeneous interests are shaping under a more open setting. However, the facility-oriented strategies by the dominant state-owned players still exert great challenge to the cloud computing development which needs sustainable benefits generated from the infrastructure. Our paper tries to provide a systematic understanding on the growth of China's emerging computing infrastructure and offer some important insights to the emerging industries in other large emerging countries.

Keywords: Actor-network theory; China; Computing infrastructure; Cloud computing; Emerging information technology; Supercomputing;

INTRODUCTION

In the past decade, the IT infrastructure has gradually become the backbone for the knowledge intensive development in the large emerging economies like China. In today's data intensive world, IT infrastructure has also served as an important driver for the technological, industrial economical and social transformation. Failures to design such infrastructures are more common incurring huge losses in foregone investments, opportunity costs, and political and social problem (Hanseth & Lyytinen, 2010).

The rapid development of China's computing infrastructure in recent years has attracted great attention from the academia, business and politician internationally. Even American president highlights the rising of China's supercomputer infrastructure in terms of calculation speed and facility quantity which address both economic growth and scientific standing.[1] This emerging context which characterized by booming economy, transforming industries and growing technology brings new opportunities to the application of the computing. As the world's largest internet, computer, and mobile market, China owns great potential of computing application compared with other developing countries. Chinese government has been deeply involved in the development of the computing infrastructures including the systems of supercomputing and cloud computing to build a nationwide computing backbone network. Super-computing receive large amount of government support in the national "12th Five-year Plan", cloud computing was considered as one of the strategic emerging industries for China to re-motivate the economic slow-down after the financial crisis[7]. Since 2009, the enthusiasm of China's government for the cloud computing triggering the surge of nationwide investment even excesses the expectation of the industry itself.

When new technological innovation meets emerging context, the two uncertainties collide and complex the process of the computing infrastructure development. Then there maybe an urgent need for the research linking the transformation of the giant computing infrastructure to the particular social, economic, political and institutional contexts in the large emerging country. Using the actor network as an analytical lens, this paper aims for a deeper understanding of the key aspects of China's emerging computing infrastructure in a more open world.

Our paper is organized as follows: in the section of literature review, previous literature related to our research was classified and further analyzed. In the section of framework and methodology, we draw upon the ANT theory to primarily develop a conceptual framework for analyzing the growth of the modern computing infrastructure. Data collection method is also elaborated. In the section of case study of computing infrastructure, in-depth case studies of supercomputing and cloud computing in China were conducted to justify our framework. The last section is devoted to further substantiating this framework with the empirical study and this paper concludes with the discussion on further possible research direction.

LITERATURE REVIEW

The actor-network theory has gained increased attention from the researchers trying to extend its applications beyond technology adoption and design to broader areas (Walsham, 1997). A key feature of actor-network theory is that the actors include both human beings and non-human actors (such as a technology), together composing a network to be studied (Callon, 1991; Latour, 1996). It encourages the researchers to disclose the interplay of the market transformation and its social system. Actor-network theory examines the motivations and actions of human actors that enroll themselves into a network and align their interests around specific non-human artifacts. Yet, actor enrolment and interest alignment alone cannot fully explain the mechanism of a change. Then a holistic approach combined technology, market and institution needed be explored to examine the growth of an industry. "Inscription" and "translation" are key concepts

for understanding the interest alignment to form an actor-network. An inscription is a form of anticipated characteristics which actors, in one way or another, try to build into an artifact (Callon, 1991). Translation implies that an actor reinterprets or appropriates the interests of other human actors and the interests embedded in non-human actors according to one's own, and has these interests represented in the inscription. The actors' interests are flexible and can be translated, enabling the interest alignment and the maintenance of an actor-network.

The process of infrastructure innovation and adoption

The development of infrastructure is not only depends on the "technology-push" and "infrastructure innovation", it also needs "innovation adoption" and "business model" to exploit the potential of existing infrastructure. There are multiple definitions about the infrastructure. The emergence and extension of the infrastructure lowers the knowledge threshold to adoption and reduces the complexity of the technologies to the users (Gao, 2007). It decreases the adoption risks and creates user favouritism towards the technologies. It also guarantees the stability of the promoted technologies, triggers learning and thereby reduces costs (Attewell, 1992). Focusing on the domain of computing infrastructure, Foster & Kesselman (2004) identify it can create a universal source of pervasive and dependable computing power that supports dramatically new classes of applications. The computing infrastructure can accelerate and foster the adoption of innovations, so enterprises prioritize infrastructure to promote innovations and unlock new sources of value (Aymerich & Fenu, 2008).

Previous literature has provided a number of important insights, ranging from the motivations and factors that influence innovation adoption to the outcomes and processes of its diffusion (Cooper & Zumd 1990, Cool et al. 1997, Damsgaard & Lyytinen 2001). The situation of user adoption of technologies and services influences the innovation of infrastructure, and requires the infrastructure enabling the provision of new, appropriate services (Abbate, 1999). According to Christensen and Knudsen (2010), business model is critical to enabling innovation adoption. And it is introduced as part of framework for thinking about systemic change, which also includes enabling technology and a careful market adoption strategy (Christensen& Knudsen, 2010). Business model is also referred to as the conceptualization and adoption of new ways of conducting economic exchanges among transaction participants (Zott & Amit, 2008), which greatly influence the innovation and adoption of a technology.

Open the black box of social network

The development and adoption of the emerging technology depends on the coordination and negotiation of different actors within the social system. For example, Muller-Veerse (2000) considers government agency, intra-governmental organizations, equipment vendors, network operators and content providers play their different roles in promoting innovation. Tilson and Lyytinen (2004) identified services designers need to understand the complex needs of all stakeholders in the overall social system. Gao (2007) defines the users, providers of mobile services and other relevant institutions as three groups of actors that represent the social interests in mobile telecommunications market. As the openness nature of cloud computing, Edwards et al. (2007) implies that social and technical diversity and heterogeneity will increase along with

the evolution of technology.

Interaction between social and technological systems

ANT adopts a socio-technical perspective into the design and analysis of technological systems in which the world is viewed as being comprised of networks of technical and social actors (Sarker & Sidorova, 2006). The central argument of actor-network is that successful networks of aligned interests are created through the enrolment of a sufficient body of actors that inscribe their interests into the network (Walsham & Sahay, 1999). A key feature of this theory is that actors are taken to include both human beings and nonhuman actors (or artifacts), such as a technology, which together compose one network (Callon, 1991). Gao& Damsgaard (2007) define mobile telecommunications market as the non-human artifact and its players consisting of social system as human actors, they use actor-network theory to analyze the social-technological evolutionary process of mobile telecommunication market innovation. Social structure and technological architecture co-evolve as technical problems are solved, and the services and products are adopted in the social domain (Tuomi, 2002).

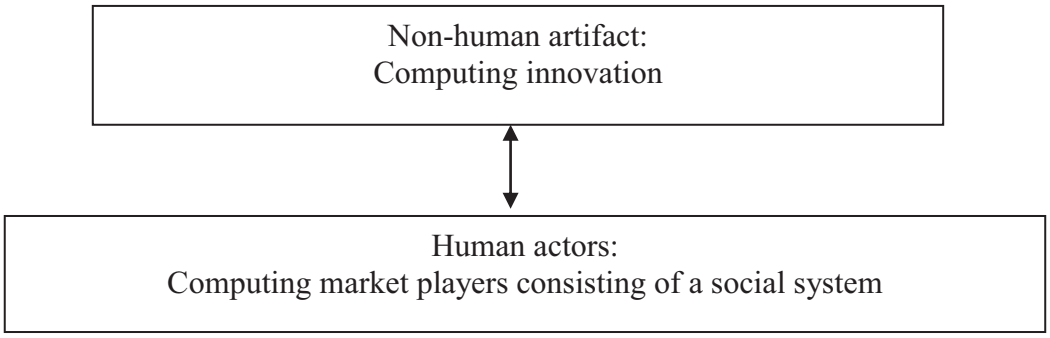


Figure 1: The preliminary framework of actor-network analysis

Literature review of computing infrastructure

There are several researches focus on the development of computing infrastructure from the perspective of technology, business, prizing, adoption and security in the developed countries (Shirley&Carol，2011). Vouk& Sills et al. (2010) exploit the integration of high-performance computing into cloud computing services from the technological perspective, they discuss a very successful production level architecture and policy framework for supporting HPC services within a more general cloud computing infrastructure. Wei (2009) identify that cloud computing makes super-computing power via the Internet free flow became possible while there still exist obstacle in fully integrated super-computing power into cloud computing. There are also some literatures concentrate on cloud computing from either technological or organizational perspective. Although some commentators categorize cloud computing services somewhat differently, the most common approach segregates services into three-part taxonomy (Foster et al., 2008; Vaquero et al., 2009; Mell & Grance, 2009). It means that the cloud computing can provide services at different layers of the resource stack, namely IAAS (infrastructure as a service), PAAS (platform as a service) and SAAS (software as a service). Some literatures also

address the merits of cloud computing in terms of reducing costs, aggregating demand, increasing reliability and transforming capital expenditures into operating expenditures (Weinhardt, et al, 2009; Leimeister, et al., 2010; Koehler and Anandasivam, 2010).

Despite there are researches focus on technology, business, prizing, adoption and security of computing infrastructure, few studies link the institutional arrangement with technological innovation especially under the context of emerging countries. And computing infrastructure is a kind of socio-technical system involving both technical and social elements and their interactive relationships. Through the lens of actor network theory, this paper tries to explore the interaction between technology, market and institution related to China's emerging computing infrastructure and then hope to provide some theoretical and empirical insights to other emerging countries.

FRAMEWORK AND METHODOLOGY

Based on the literature and analysis in the above sections, we propose an analytical framework to examine the socio-technological mechanism for the computing infrastructure innovation, as shown in Figure 2.

In terms of the business firms involved in cloud computing, here we define four types of actors including system providers, service providers, institution and users to represent the interest in our social network. In identifying these elements, it is necessary to consider whose interests these human candidates represent (Walsham, 1997). System providers mainly concentrate on the computing facilities and terminal while the service provider concentrates on creating, configuring, operating and distributing services for the users.

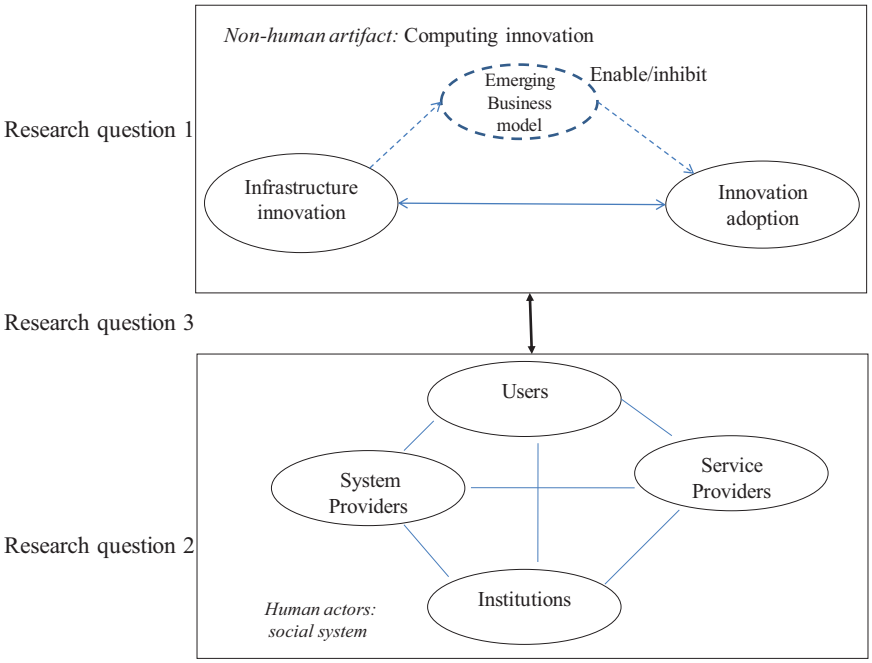


Figure 2: A framework for analyzing computing market innovation

As depicted in the framework, the research questions we try to explore and exploit are as follow: Question 1: How do the infrastructure innovation, business model and innovation adoption co-evolution?

Question 2: What actors are enrolled into the social system in the development of supercomputing and cloud computing?

What are the characteristics of their interactions in the social system? What are their roles in computing innovation?

Question 3: How does the social system determine the innovation, and in return how does the innovation situation influence the properties of the social system?

We have conducted a case study of China to justify our framework. Specifically, we draw upon our framework to give a systematic analysis on the development initiatives of the supercomputing and cloud computing which promote computing market innovation. In line with our framework, the case study argues that it is the status of the interplay between the innovation and its social system that determine the successful or failed diffusion of a specific technology.

DATA COLLECTION

Carrying out a longitudinal study on the transformation of China's computing infrastructure requires capturing changes in information technology and the market, analyzing the dynamic contexts within which the transformation takes place, and exploring key stakeholders' perceptions of the market change (Walsham, 1995). The authors of this paper first engaged in the field observations (Yin, 1994). Second, from October 2010 to December 2012, more than thirty interviews were conducted in the main players including major system vendors, research institutions, public authorities, and operators in Chinese computing market. Finally, to identify the order of critical events within the computing infrastructure development in China, the authors used archival documents, including news reports in official newspapers, speeches of ministers and national leaders, and the annual reports of computing infrastructure development in China published by MII, MOST and MIIT.

The data collected by these different means were cross-validated before use (Strauss and Corbin, 1998). We engaged in two types of dialogical reasoning while interpreting the collected data. During the discussion between the authors, we triangulated the data from one perspective that had a deeper Chinese background. And from another perspective, we analyzed it from the view point of several outsiders generally entrenched in policies and businesses. This dialogical perspective also allowed us to engage in discussion with the practitioners who acted in the Chinese context (Monterio and Hepso, 2002).

Case Study of China's Computing Infrastructure

China was confronting more pressure from global market after joining in WTO and was trying to alter their current business models from low-cost, low-margin to an orientation that supports innovation and collaboration along the global value chain. There are also the increasingly needs for data storage, data processing and data computing to speed the economic transformation of the millions of SMEs in China. Effective design for such service capability to support the transformation by exploiting the existing computing infrastructure becomes critical to China.

Table1, 2 and 3 condensed the analysis of our case study to verify the framework. We will elaborate them in this section.

Table 1: Computing innovation

	Super computing	Cloud computing
Infrastructure Innovation	There is a rapid development of China's super computer both in terms of quality and quantity	Supported by broadband networks, the high-efficiency and green data-processing center as well as large-scale distributed storage and computing capacity supports various businesses.
Innovation	The innovation adoption was	The adoption of cloud computing

	Super computing	Cloud computing
Adoption	limited to the macro project in the domain of energy, climate and others. Only few large enterprises can get access to these computing resources.	follow a service oriented strategy, which involve a collection of users various from large enterprise, SMEs, government to individual.
Business model	Lacking of Effective business model	Business model is imperative to enable the transformation from technology innovation to innovation adoption in cloud computing.
Dynamics	Facility oriented	Service oriented

Table 2: Comparison of social system between supercomputing and cloud computing

	Super computing	Cloud computing
Institutional intervention	Intervening in the technology innovation and adoption directly follow the performance-based paradigm	Intervening in the deployment of infrastructure rather than innovation adoption.
System providers	The public universities, institutes and state-owned companies like NUDT (National University of Defense Technology), CAS (Chinese Academy of Sciences) and Sugon.	The domestic equipment provider such as, Lenovo, Sugon and Huawei, the transnational equipment manufacturers such as IBM, EMC and Intel
Service providers	Specific supercomputing center	The domestic internet companies represented by Sina, Tencent and Alibaba, telecom operator such as China telecom, China unicom and China mobile as well as the cloud computing centers that collaborate with local governments.
Users	Academic institutes, Large state- owned enterprise,	Large enterprises, SMEs, government, academic institutions, universities, public agencies and individuals

	Super computing	Cloud computing
Institutional intervention	Intervening in the technology innovation and adoption directly and following the performance-based paradigm	Compare with intervention in the deployment of infrastructure the stimulation in innovation adoption has relative lagged behind.
Interrelation between service providers, system providers, users and institution (interest mechanisms)	Both service providers and system providers were directly initiated and guided by government, users concentrate on the macro projects in the domain of energy, climate and others.	Government push the wide application of cloud computing. The emerging business model which involved in large range of enterprise, individual and institute (suppliers and users) serves as the engine of cloud computing.

Table 3: Research questions addressed

Question 1	➢ China's supercomputing capacity mainly adopted in the domain of energy, climate and others. Both the technological innovation (the development of super-computer and the establishment of supercomputing centre) and service adoption are promoted by the institutional intervention, while the effective business model was lacking to bridge the gap between infrastructure innovation and innovation adoption. ➢ Cloud computing can provide broad spectrum service to heterogeneous users like large enterprise, SMEs, government, individual, and among others. China's quick development of broadband networks and related computing facilities motivates the adoption of cloud computing by domestic users. Emerging business model enable the wide innovation adoption of cloud computing and self-reinforcing development of the computing market.
Question2	➢ In supercomputing, China's government follows facility oriented strategy to directly intervene into the development process of super computers, the operation of supercomputing centers and the application of computing capacity by system providers, service providers and users respectively. China's highly specified system providers supply super computer and related facilitates to or cooperate with the service providers. Service providers tailored the facilities by the approach of directional bidding among domestic system providers which is administrated by the

	government procurement. These supercomputing service providers provide computing service to the national institutions according to government's guidance.
	➢ In cloud computing, central and local government's investment incentives play a critical role in enhancing the dynamics of system providers and service providers. By the end of 2011, nearly 20 metropolitan governments announced large cloud computing and data center investments and projects. It demands more coordinated response from governmental agencies. System provider need to ensure the scalability, flexibility and reliability of the computing facilities, and optimal the facilities' cost and maintenance expenditure to enhance their attractiveness for service providers. New service capabilities of the service providers could be tried out by tackling a new problem with enough complementary capabilities or new applications.
Question3	➢ In supercomputing, both the technology innovation and adoption were greatly stimulated by the institutional intervention of Chinese government. For example, the Tianhe1A and Dawning Nebulae are mainly supported by national 863 projects. These established computing infrastructures are serving for the national researching and engineering projects, which are dominated by the state owned institutions.
	➢ Chinese central and local governments have tried to address the infrastructure innovation and innovation adoption by encouraging capital investment of domestic service providers. The establishment and maintenance of reliable computing infrastructure also stimulated the engagement of relative actors from different sectors.

The development of supercomputing (from 1989)

1. From technology innovation to innovation adoption

The development of Chinese supercomputing follow a top-down and facility oriented strategy. The development of supercomputing was motivated by government's initiative to stimulate the rapid development of pillar industry and ensure the sovereignty and security of the country. In 1989, the State Planning Commission, the State Science and Technology Commission and the World Bank jointly launched a project to develop networking and supercomputer facilities including three supercomputer centers in China (Fan, 2001). China gradually accumulated technological capability and research expertise under government's facility oriented strategy. Then the first decade of the 21st century witnessed the dramatic progress of supercomputing in

China, the computing peak speed of the fastest supercomputer climb from 51st in June 2003 to 5th during 2005 in the top 500 list[9]. By mid-2010, China's supercomputer Nebulae had reached the 2nd spot and a Chinese supercomputer, the Tianhe-1A, from the National Supercomputing Center in Tianjin briefly became the world's fastest at the end of 2010(Jonathan, 2010). As for China, the race to build the fastest supercomputer in the world has become a source of national pride to some extent.

Although there has been a rapid development of China's super computers in terms of theoretical peak speed, the innovation adoption was limited to the macro projects in the domain of energy, climate or scientific. Generally they are targeted to small groups of public institutions, who were interested in accessing powerful and expensive computing resources. Few large firms can get limited access to these computing resources and the computing potential is far from being fully utilized.

As one director of National Supercomputing center[10] said in an interview:

"Currently, we tend to purchase the supercomputer equipment from the domestic providers like Sugon or Lenovo other than foreign firms. The speed performance of domestic products can meet our operation requirement since the architecture of the supercomputer become mature. As for our customers, the academic computation demands mainly come from large domestic research institutes, only few large state-owned enterprises in oil or aviation sectors need supercomputing service. Actually, our computing service charge only covers the electricity cost. The investment and maintenance cost of our machines mostly come from the government, and we have very limited initiative to explore the new market. "

Both the technological innovation and innovation adoption are promoted by the direct institutional intervention, while the effective business model was lacking to bridge the gap between them. Address government intervention and neglect business model forming cannot ensure the sustainable and self-reinforce development of supercomputing industry.

2. Social system

Supercomputing industry involves in a small number of actors that is designated by government. The powerful computing systems owned by the government are valued for their ability to solve mission tasks for national interests in areas like climate, energy, finance, science and defense. This industry operates as a stand-alone system rather than a scalable and shared user re-configurable resource (Vouk et al., 2010). Government support the emerging and recent development of supercomputing through national programs. From the late 1990s, China launched one research program named "national HPC environment". From 2001 to 2005, the mega project about high performance computer and core software was started. In the late 2000s, MOST (Ministry of Science and Technology) founded the "Mega 863" project concentrate on "High performance computer and grid service environment" which aims to develop the high performance computer capable of carrying out thousand trillion level calculations a second and established the high performance computer capable of carrying out 300 trillion calculations a

second. Supported by the "national 863 project", National University of Defense Technology (NUDT) research and developed Tianhe1A which ranked the world first in October 2010. The government has followed the facility-oriented strategy to directly intervene into the development and operation process of super computers by system providers and service providers respectively. After the development of domestic supercomputer, several supercomputing centers are being built in Changsha, Shenzhen and Beijing. These Chinese systems are depending on chips made by the American companies like Intel and Nvidia while the key interconnect, or networking technology, developed by Chinese researchers(Ashlee,2010).

Table 4 depicts the 'China Top10 List of Super Computer in 2011', we can observe that the leading system providers for supercomputing are mainly domestic actors like NUDT, NPCETR [11] or Sugon, which supplies the supercomputers and related facilitates. They have established the stable interest alignment with the national supercomputing centers which provide the computing service to the targeted limited national institution users. These computing users concern more about the computing speed and technological capability. Other foreign system providers like IBM choose to supply their products to the business users.

Table 4: China Top10 List of Super Computer in 2011

Rank	Vendor	Country original	System	Installation Location	Service area	Linpack (Gflops)
1	NUDT	China	TianHe OneA	National Supercomputer Center in Tianjin	Scientific Computing /Industry	2566000
2	NPCETR	China	SunwayBlueLight	National Supercomputer Center in Jinan	Scientific Computing /Industry	795900
3	NUDT	China	TianHe OneA-HN	National Supercomputer Center in Changsha	Scientific Computing /Education	771700
4	Sugon	China	SUGON NEBULA/	National Supercomputer Center in Shenzhen	Scientific Computing /Industry	749200
5	IBM	U.S.	xSeries x3650M3/	Network Company	Internet Service	636985
6	IPE,CAS	China	Mole-8.5 Cluster/	Institute of Process Engineering, Chinese	Scientific Computing	496500

Rank	Vendor	Country original	System	Installation Location	Service area	Linpack (Gflops)
				Academy of Sciences		
7	Sugon	China	Sugon NEBULA/	National Supercomputer Center in Shenzhen	Scientific Computing /Industry	342300
8	IBM	U.S.	xSeries x3650M3/	Telecom Company	Industry	204754.4
9	IBM	U.S.	xSeries x3650M2 Cluster/	Network Company	Internet Service	196228
10	Sugon	China	Magic Cube/SUGON 5000A/	Shanghai Supercomputer Center	Scientific Computing /Industry	180600

Source: "2011 China TOP100 List of High Performance Computer" released by the Specialty Association of Mathematical & Scientific Software (SAMSS), CSIA

3. Interaction of computing innovation and social system

Both the technology innovation and development of supercomputing were greatly stimulated by direct institutional intervention of the government. China's supercomputing industry is strongly motivated by the government's pursuing of technology breakthroughs with a technologically elegant innovation in one great leap. These established computing infrastructures are mainly serving the national science programs in the domains of energy, climate, astronomy, geography and medicine, which are dominated by the state owned institutions. However, these computing infrastructures couldn't be fully exploited and contribute to the social and economic development directly. Only the limited public users can access such expensive and centralized computing resources. Then the infrastructure designers, developers and users couldn't be effectively intertwined to build strong interest communities for the infrastructure.

Emergence of cloud computing (from early 2009)

Since 2009, the advent of cloud computing has somewhat changed the traditional supercomputing landscape in China. Cloud Computing is more considered as an IT deployment model than a pure technological breakthrough, where resources, in terms of infrastructure, applications and data are deployed via the internet as a distributed service by one or several service providers. These services are scalable on demand and can be priced on a pay-per-use basis and the cloud computing utilizes on-demand network access as a means to connect the user to a shared pool of resources (e.g., networks, servers, storage, applications, and services) based

in the cloud (Shirley & Carol, 2011). This new paradigm is regarded as a solution for reducing IT investment costs, minimizing management effort, and improving business process (Armbrust et al. 2010).

Affected by the worldwide financial crisis in 2008, China suffered a sharp reduction her export and manufacturing sectors. In the effort to resist this recession, China was forced to transform its developmental engine from low cost based manufacturing and assembling sectors to knowledge intensive sectors. However, the computing facilities supporting millions of SMEs are still quite weak. The emerging cloud computing model based on the growing computing infrastructure becomes an attempt to enhance the competence of the Chinese firms under the global fierce competition.

1.Computing innovation

Since 2009, a significant change emerged in terms of the business models and service patterns of computing architecture in China. As an service oriented innovation, cloud computing emphasize more on the reconfiguration of market and industrial structure rather than just concentrate on the disruptive technology advancement. Main cloud computing service and solutions are based on utilizing existing IT technology and infrastructure, which greatly speed the constructing of the industrial value chain. By utilizing cloud computing, large amount of SMEs can exploit the potential of their obsolete computers or other computing facilities in the future. Since the early 2000s, the large internet companies such as Alibaba, Baidu and Shanda start to provide cloud based services like SaaS solutions. A lot of SMEs benefit from this internet-based computing services like e-commerce data mining, a big data processing and data customization.

Stimulated by the increasing needs of knowledge and information based industrial transformation, China attached great importance to the establishment and maintenance of supporting infrastructure like broadband network. After several decades of development, China's network user scale ranked first in the world and maintained high growth rate. As of December 2010, China had 457 million internet users and 126.34 million broadband subscribers [3]. Although there were large number of broadband network users, the statistics show China's broadband network penetration rate was 9.49% percent in 2010(MIIT).

As the low penetration rate of the broadband network and the unbalanced development of networks in different areas restrain the development of cloud computing in China, incumbent telecommunication operators become a central actor for the cloud computing under such contexts. Since 2009, China Mobile, China Telecom and China Unicom began to launch their cloud computing research and development centers under the support of provincial and cities' governments. Their most IDCs (Internet Data Center) can be extended from providing original server hosting and renting function to support data storage, processing and service supporting various Internet and e-commerce businesses. In 2010, these telecommunication giants enlarge their investment breadth to extend and rebuild the IDCs into cloud computing centers. For example, China Mobile established its international information harbor especially concentrate on IDC centers in Beijing. China Unicom's IDC center and cloud computing operation center was

positioned in Shanghai, which will invest 500 million in the next five years.

Table 5 : The capital investment of Chinese telecom operators to IDCs from 2009 to 2010

	2009	2010
China telecom (million)	69.81	109.86
China Unicom (million)	46.22	75.74
China Mobile (million)	14.18	24.47

Source: Cloud computing market report of CCIDC consulting(2010)

Compared with supercomputing segment, the system providers in cloud computing sector need not to concern about over-provisioning for a service with least popularity, thus wasting costly resources, or under-provisioning for one that becomes wildly popular, thus missing potential markets and revenue (Michael et al.,2010). The virtualization, one of the core enabling technologies for cloud computing allows the computing power of a single machine to be subdivided into a number of smaller virtual machines which will ensure the ubiquitous and unlimited providing of computing utility for the business application. The increasingly diversified demand which exploit the innovation potential and motivate the infrastructure deployment.
Users can also benefit from cloud computing by purchasing software, storage and computing power on a pay-as-needed basis. The successful adoption of cloud computing need a kind of service-oriented strategy, which involve a collection of users like large enterprises, SMEs, government agencies and individual. Recently, Most of the business models adopted by domestic service providers are transplanted horizontally from large MNCs in the similar business domain with minor localized modification. So the emerging business model which is tailored to China's context is imperative to enable service adoption.

By the end of 2011, nearly 20 metropolitan governments such as Beijing, Chongqing, Shandong, Shanghai and others have announced large cloud computing and data center investments and projects. These local governments are targeting to the great needs for local economic upgrading. By September 2011, China has invested about £98 billion in cloud computing to build the data hub in Asia[2]. The system providers and service providers also actively involved in this investment surge to capture more business value.

As one senior official of local government said in our interview:
"We consider our cloud computing center which equipped with thousands of computer servers as a high-end image for local industry upgrading. The cloud computing is the next generation IT technology, and it seems to create a 'high-tech' investment environment and infrastructure like high-speed railway. You know, we must compete with other large cities in China in the 'emerging industries'. Those large telecommunication operators also hope to collaborate with us as they hope to capture more business value from the customers by exploiting their existing network and data centers if the whole cloud computing industries really take shape. Those large domestic system vendors also hope to sell their computing servers or other equipments to us

under the grand cloud computing plan.

We tend to cooperate with these large state-owned firms as they can attract more policy supports and national programs from the central government. Furthermore, we consider' cloud computing' as a strategic platform to stimulate the quick growth of our electronics hardware and software industries even the cloud computing itself could not earn money in the future . "

Table 6: Investment activities and main partners of local governments in cloud computing

City	Established time	Development visions announced	Main Partners
Wuxi	Feb. 2009	Cloud Valley of China	IBM, Sugon
Chengdu	Dec.2009	Cloud computing centre in middle west, Supercomputing centre in Chengdu	CAS; Sugon
Shanghai	Aug.2010	Asia-Pacific cloud computing centre	China Telecom, Shanghai Supercomputing center
Shenzhen	Sep. 2010	Cloud computing centre of Yangtze Delta	Sugon
Beijing	Oct. 2010	Cloud computing industrial centre in the world	Sugon, China Telecom
Tianjin	Oct. 2010	National leading cloud computing centre	HP
Ha'erbin	Nov. 2010	Chinese cloud valley， Data-centre city	China Mobile, Inspur
Foshan	Feb. 2011	Cloud computing centre of Guangdong province	China Telecom
Ningbo	April.2011	Cloud computing application centre	China Telecom
Chongqing	Mar.2011	International off-shore cloud computing trial district	CAS, Sugon
Dongguan	Mar. 2011	Innovation and cultivation centre of Cloud computing	CAS
Qingdao	May 2011	Data centre of northern China	China Unicom

City	Established time	Development visions announced	Main Partners
Hangzhou	May 2011	National developmental and training platform of cloud computing	Microsoft
Suhzou	July 2011	National cloud computing platform	SIP International Science Park Development Co. Ltd; Tsinghua University
Jinan	Aug. 2011	High-tech park computing centre in China	Inspur corporationu
Nanjing	Aug. 2011	National base of cloud computing	Sugon
Hefei	Nov. 2011	Cloud computing application platform	Inspur corporationu
Huhehaote	Nov. 2011	Largest data center for cloud computing in China	China Telecom, China Mobile
Xi'an	Dec. 2011	National cloud computing application platform	China Telecom,

Source: Data are collected from the government documents and the annual reports published by MPT and MII, then compiled by the author.

2. Social system

The actors identified in the social system are the system provider, service providers, users and institution. These actors can represent the interest inscription and transcription of the whole social system. Compared with supercomputing, cloud computing enroll much broader interest of different sectors. The system providers in China composed of foreign equipment providers, domestic equipment providers and SMEs, The service providers include the domestic internet companies and telecom operators as well as some cloud computing centers built by local governments. In terms of social system, the networks of much more diversified actors with heterogeneous interests are becoming to shape for the could computing. Internet firms and traditional telecommunication operators are also engage in cloud computing as service providers. which have missed the supercomputing development. These actors formulate diverse convergence strategies to pursue their own interests, they also interact with other actors to make the network possible. They still haven't been intertwined to develop the necessary communities.

The service providers of cloud computing required the reliable, efficient, and secure equipments from the system providers. New service capabilities of the service providers could be tried out

whenever the users with problem and enough complementary capabilities could leverage upon the new application. And the cloud users are diversified in large enterprises, SMEs, government, academic institutions, universities, public agencies to individuals. The institutional intervention is necessary to mobilize resources, to create economies of scale, or subsidize innovation (King et al., 1994). After the financial crisis, the central and local governments in China are eager to upgrade the giant low-cost based industry. Centre and local government's investment incentives play a critical role in enhancing the dynamics of system providers and service providers.

In late 2010, the Chinese government announced their 12th Five Year Development Plan outlining their plans for social and economic development for 2011-2015, and designating 'next-generation information technology' as one of seven 'Strategic Emerging Industries'. These industries will receive special investment and development to create the basis of China's long-term economic growth and home-grown innovation. Cloud Computing was highlighted as one of the key investment areas within next generation IT by government for development of new digital technology and infrastructure.

More and more metropolitan cities in China are trying to build up the cloud datacenters and establish the cloud platform to improve the local investment environment. The local government is expected to adopt more aggressive measures to introduce more service provider and system provider to leverage the infrastructure. In October 2010, the trial projects for cloud computing services are decided to be launched in Beijing, Shanghai, Shenzhen, Hangzhou and Wuxi [4]. Cloud computing has then come into the trial and implementation phase in China. China also established two major cloud computing technology industrial parks in Beijing and Shanghai, attracting billions of investment.

In October 2011, the central government provided the development subsidiary for the domestic technology companies including the Alibaba and Baidu by providing assistance in research, planning, and guiding their technology and product roadmaps to make them more competitive in local and global markets against the international players. Given the enormous market potential in the long term, many international service providers hope to entry China's cloud computing market with different partnerships. For example, Microsoft has announced partnership with China Mobile on Cloud solutions and SAP has announced partnerships with China Telecom to provide cloud applications in China.

Given the promotion and investment by the central and local government, the security and standard emerged as a prominent obstacle stumble the widely adoption of cloud computing. And in most cases, the government is still absent in administrating the standardization, security and privacy of data. For the vast personally identifiable information as well as financial information, cloud data security has become the largest concern. Government need to make regulations to intervene the cloud-based solutions and assure these institutions that their data are being handled in a way that preserves confidentiality by giving users greater ability to control the manner in which their traffic passes through the access networks.

Considering the emerging and transforming context of China's economy, service providers can enhancing the data storage and process efficiency of diversified users by exploited the potential of cloud computing. For large company users, the service providers can mitigate the need to establish and maintain server and storage capacity by these companies. As for most SMEs, they often lack enough computing resources supporting business applications. The computing service from service providers which needs no upfront investment will allow the SMEs access the vast computing resources with the affordable prices. Cloud computing has great market potential because China possess large amount of SMEs with poor IT facilities and applications. By providing the computing services to heterogeneous users simultaneously, service providers aggregating users' demand and reduce the decentralization which helps achieve higher utilization rates than individual enterprises achieve on their own.

3. Interaction of computing market and social system

China's knowledge intensive and information oriented development stimulate almost the entire industry participants, enterprises and users to confront this emerging market innovation. Both the Chinese government and industries realized that China is now behind leading MNCs in leveraging the existing computing resources. Many service capabilities have been established when the market needs have been recognized by the service and system providers.

The networks of aligned interests for cloud computing in China are still in the initial shaping stage. The infrastructure developers and users need to be the innovators for service capabilities and organizers for the interest alignment. The central and local governments have tried ambitiously to address the infrastructure innovation and innovation adoption. The cloud computing also demands more coordinated response from the institutional system other than direct investment. Government also supports infrastructure buildinglike broadband network which are imperative to innovative products or processes.

The computing infrastructure in China: past, present and future

In 1989, a program to develop networking and supercomputer facilities including three supercomputer centers was launched in China. Afterwards, China's technology and application capability of supercomputing was accelerated gradually. The national 863 program greatly stimulate the capability enhancement of supercomputing and enable China's super computer took off after 2000. Tianhe-1A and Dawning Nebulae even ranked among the world's fastest super-computers in 2010. However, these super computing resources mainly cater to the need of national institutions in the domain of energy, climate and others. Though China's computing infrastructure has grown over the years enormously in terms of new services and capacities, a proactive business model was still lacking and the supercomputing technology met great difficulties in finding mainstream business application.

Since early 2009, the initial deployment and application of cloud computing began to emerge in China. Motivated by the central and local government, the cloud computing was developed rapidly by various actors. The cloud computing provides the service for the heterogeneous users from large enterprises, SMEs, government to individuals. This diversified demand is

different to be met by supercomputing which only need to provide specific high speed computing resources to the limited public users. At current stage, supercomputing and cloud computing serve their users respectively in China. And some large enterprises are transforming their computing demand from supercomputing to cloud computing for their relative low requirement of computing speed.

There is a trend of sector confluence are in computing industry. After the broadband network developed and the flexibility of supercomputer enlarged to a certain extent, some existing supercomputing facilities can evolve into the basic infrastructure of cloud computing which will provide broader service to the more diversified users.

Although the need is limited in the beginning stage of cloud computing, more market application will be discovered later when new service capabilities of the actors start to grow. And more actors can be attracted to try some of the novel characteristics of the cloud-based application. The system providers and service providers also need work together to configure application capabilities for the sustainable development. Thus the computing infrastructure in China can provide a much more ubiquitous, fast and reliable service to its users.

Table 7 : Milestone of computing infrastructure in China

Time	Events
Aug. 1989	The State Planning Commission, the State Science and Technology Commission and the World Bank jointly launched a project to develop network and supercomputer facilities including three supercomputer centers in China
May 1990	The computer network center of Chinese Academy of Science was founded
Apr.1994	China's computing and network facilities connected to American internet, which marks the establishment of first international connection internet in China
Apr. 1995	The establishment of supercomputing centre of Chinese Academy of Sciences
Dec. 2000	The establishment of Shanghai Supercomputing Center
Feb. 2006	Supercomputer development was highlighted into “National Guideline on Medium-and Long-Term Program for Science and Technology Development of China(2006-2020) ”
Nov. 2008	Chinese super computer named “Magic Cube” ranked 10th in the international top 500 supercomputer

Time	Events
Sept.2009	Alibaba establish the sub-company specialized in cloud computing
Dec. 2009	Chengdu supercomputing center was founded as the commercialized computing centre for cloud computing.
Otc.2010	Tianhe-1A supercomputer reach the top spot in the world
Otc.2010	MIIT (Ministry Of Information And Industry Technology) and NDRC (National Development and Reform Commission) issued a circular regarding cloud computing services innovation trials and announced five cities for conducting trial cloud computing service.
Otc.2011	NDRC established the special funding which including 660 million RMB investment to support the companies engaged in pilot cloud computing projects in five trial cities.
Until the end of 2011	Nearly 20 metropolitan governments have announced the large cloud computing and data center investments and projects

Source: Collected by the authors from diversified reports and verified by the interviews

DISCUSSION, LIMITATION AND CONCLUSION

Today's computing infrastructure involves higher complexity that extends beyond what can be addressed by traditional supercomputing approaches. As China's computing infrastructure is still rapidly growing, we should explore it from a dynamic perspective. Through the lens of actor network theory, we explore the social-technological evolution across the institutional arrangement, technological innovation and application evolution of China's computing infrastructure. Here we define four types of actors in the social system to represent the different interest communities. The framework was constructed to explain how the interactions among the actors identified forge the growth of the infrastructure.

We then conduct an in-depth case study of computing infrastructure in China to justify our framework. The case study demonstrates that, our analytical model offers a higher explanatory power compared with a traditional innovation, adoption or business model theory. China's economic and political environment determined the growth characteristics of her computing infrastructure. We find that computing infrastructure is not intentionally built but emerging in nature and continuously growing. The infrastructure innovation, business model and innovation adoption co-depend during the growth process. Therefore, the capabilities of involved actors were enforced to exploit potential of the established computing infrastructures.

Initially, the performance-driven supercomputing becomes the prominent component of China's computing infrastructure. The development of supercomputing in China follows a relatively closed paradigm. As it enrolled few large state-owned enterprises and the interest translation and inscription is relative clearly. This closed paradigm can efficiently coordinate the interests among limited actors in social system and stimulate the facility oriented and performance driven development of domestic supercomputers.

The increased processing power and higher transmission and storage capacity have made it possible to build the computing infrastructure with higher flexibility for the more diversified users in China. As Lyytinen and Yoo (2002) identifies, ubiquitous computing will come of age and the challenge of developing ubiquitous services will shift from demonstrating the basic concept to integrate it into the existing computing infrastructure and build widely innovative mass-scale applications that will continue the computing growth.

The emergence of the cloud computing began to reconfigure the structure of the computing infrastructure. Under a highly open setting, cloud computing enrolled much more diversified players originally in different sectors which enhance the complexity of interest capture and transformation among the different actors. As cloud computing is a mix of resources and services that have profound economic and social impacts. Then organizing and connecting the heterogeneous actors with diversified interests are critical for the sustainable growth of the computing infrastructure. The computing infrastructure will grow adaptively and re-organize constantly with new connections between different actor communities. Chinese central and local governments also used preferential policies to support the emerging cloud computing in constructing a broad and flexible computing infrastructure for the industrial upgrading.

However, China still adopts the facility-oriented strategies in cloud computing development while the appropriate business model forming becomes somewhat overlooked. Given the premature developing stage of Chinese knowledge intensive and information oriented industries' transformation, the interest alignment within the actor network couldn't be achieved with the pure facility-expansion paradigm. In this case, demand for computing market heavily depended on the incentives that policies created and there also existed the possibility that public spending crowds-out private investment (Goolsbee, 1998). However, as the investments that took longer to pay off, the uncertainty in market expectations may have dampened the potential incentives of social capital.

When linking the institutional arrangement, technological innovation and application evolution to explore the evolution of sector in emerging context, institutional arrangement plays a critical role. This facility-based and mission oriented policy paradigm will encourage the involved firms to pursue technology breakthroughs with a technologically elegant innovation in one great leap or leapfrog (Spencer and Murtha, 2005). However, the direct intervention in the infrastructure innovation and innovation adoption will limit the actors in social system. Lacking of efficient business model affects the sustainable growth of China's computing infrastructure. Therefore, Service oriented policy paradigm should be adopted, as the diffusion of certain new technologies in the market is the result both from the providers' push and the users' pull, subject to the influence of different institutions (King, 1994). This service -oriented strategy

concentrates on acquisition, diffusion and assimilation of technologies existed in the relative sectors and enrolls much broader actors in the social system.

Considering the special institutional context of China, in order to maximize the potential benefits of cloud computing, government needs to establish the legal and regulatory framework that promoting innovation, stimulating the construction of infrastructure to guarantee the privacy, security and safety of data. The innovative computing services demands that technological, business and social concerns be integrated effectively into the overall design. More attentions need to be paid to manage the critical relationships with regulators, correct timing, and effective and continuous meshing of the concerns for the data security, privacy and standardization. However, the frequent changes of the policies in China made potential market demand volatile. A predictable and transparent policy regime will decrease the uncertainties of the institution and motivate this sector by attracting more actors home and abroad into the social system. The policies about data security and service standardization also need to be consistent with the local, regional, and national levels can also stimulate the incentives of market players.

As the computing infrastructure of China is still in its infancy, more research needed to be conducted to beyond Chinese context. Our model may be used to examine and compare computing infrastructure in different emerging countries.

Notes:

[1] The Wall Street Journal *Text of Obama's State of the Union Address* January 25, 2011
[2] Anuradha S., China to invest £98 billion in cloud computing – Computerworld UK, 14 Sep 2011, "Cloud Readiness Index," published by the Asia Cloud Computing Association
[3] Source: MIIT
[4] Source: The document of NDRC and MIIT
[5] Source: http://www.022net.com/2012/3-27/435217372478690-2.html
[6] American President Barack Obama in his State of the Union address stressed China's advancement in the fastest super-computer .
[7] State Council's Decision to Accelerate the Development of Strategic Emerging Industries

[8] According to the literal information from Huawei Cloud-computing Conference 2011
[9] http://www.top500.org/
[10] National Supercomputing center is approved and invested by government to provide high-performance computing services.
[11] Jiangnan Institute of computing technology

REFERENCES

1. Adomavicius, G., J. C. Bockstedt, et al. (2008). "Making sense of technology trends in the information technology landscape: a design science approach." *MIS Quarterly* 32(4): 779-809.
2. Abbate, J.(1999). Inventing the Internet. Cambridge, MA: MIT Press.
3. Armbrust, M., A. Fox, R. Griffith, A. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, I. Stoica, and M. Zaharia.(2010) "A view of cloud commpting," *Communications of the ACM* 53 (4):50-58.
4. Ashlee Vance (2010). China wrests supercomputer title from U.S. The New York Times http://www.nytimes.com/2010/10/28/technology/28compute.html (accessed 25th March 2012).
5. Attewell, P. (1992). Technology diffusion and organizational learning: the case of business computing, *Organization Science* 3 (1): 1-19.
6. Aymerich F.M., Fenu G., Surcis S. (2008) An approach to cloud computing network", 1st International Conference on the Applications of Digital Information and Web Technologies, (Ostrava, Czech Republic, Aug 4-6):120-125.
7. Banerjee, P. and Chau, P.Y.K. (2004) 'An evaluative framework for analyzing e-government convergence capability in developing countries', *Electronic Government: An International Journal* 1(1):29–48.
8. Callon, M. (1991). "Techno-economic networks and irreversibility", in *A Sociology of Monsters: Essays on Power, Technology and Domination,* J. Law (ed.), London: Routledge pp.132-161.
9. Cooper, R. and Zmud R. (1990). "Information technology implementation research: a technological diffusion approach," *Management Science* 36 (2):123-139.
10. Cool, K. O., Dierickx, I. & Szulanski, G. (1997). Diffusion of innovations within organizations: electronic switching in the bell system, 1971-1982. *Organization Science* 8 (5): 543-559.
11. Christensen, M, T Knudsen. (2010). The design of decision-making organizations, *Management Science,* 56 (1): 71-89.
12. Damsgaard, J. and Lyytinen K. (2001). "The role of intermediating institutions in the diffusion of electronic data interchange (EDI): How industry associations intervened in Denmark, Finland, and Hong Kong," *Information Society* 17 (3): 195-211.
13. Edquist, C. (1997), Systems of Innovation: Technologies, Institutions, and Organizations. London: Pinter.
14. Edquist, C. (2003). The Internet and Mobile Telecommunications Systems of Innovation. UK: Edward Elgar.
15. Edwards, P., Jackson, S., Bowker, G. and Knobel, C. (2007). Report of a workshop on 'history and theory of infrastructures: lessons for new scientific infrastructures', University of Michigan, School of Information.
16. Fan, X. (2001) Communications and Information in China: Regulatory Issues, Strategic Implications. University Press of America
17. Foster I., Kesselman C. (Eds.) (1999). The grid: blueprint for a future computing infrastructure, Morgan Kaufmann, San Francisco, USA.

18. Gao, P. and Damsgaard, J. (2007). "A framework for understanding mobile telecommunications market innovation: A case of China." *Journal of Electronic Commerce Research* 8(3): 184-195.
19. Goolsbee, A.(1998). Does government R&D policy mainly benefit scientists and engineers?
20. *American Economic Review* 88 (2), 298–302.
21. Hanseth,O and Lyytinen,K .(2010). Design theory for dynamic complexity in information infrastructures: the case of building internet, *Journal of Information Technology* 25(1), 1–19
22. Jonathan F. (2010). China aims to become supercomputer superpower by technology reporter, BBC News, 31 May 2010. http://www.bbc.co.uk/news/10181725 (accessed 5 March 2012)
23. King, J. L., Gurbaxani, V., Kraemer, K. L., McFarlan, F. W., Raman, K. S., & Yap, C. S. (1994). Institutional factors in information technology innovation. *Information Systems Research*, 5(2):139–169.
24. Kushida, K. E., J. Murray, et al. (2011). Diffusing the cloud: cloud computing and implications for public policy. *Journal of Industry, Competition and Trade* 11: 209–237.
25. Koehler, A. and Anandasivam A. (2010). "Cloud services from a consumer perspective," proceeding of Americas Conference on Information Systems.
26. Leimeister, S., Riedl, C., Böhm, M., Krcmar, H. (2010). The business perspective of cloud computing: actors, roles, and value networks. 18th European Conference on Information Systems (ECIS), Pretoria, South Africa.
27. Latour, B. (1996). Aramis or the Love of Technology. Harvard University Press, Cambridge, MA.
28. Lyytinen K. and Yoo Y.(2002).Issues and challenges in ubiquitous computing. *Communications of the ACM.* 45(12):62-96
29. Muller-Veerse, F. (2000), *Mobile Commerce Report*. London: Durlacher Research Ltd.
30. Sarker, S., & Sidorova, A. (2006). Understanding business process change failure: actor-network perspectives. *Journal of Management Information Systems* 23(1), 51−86.
31. Shirley O. Y., Carol H (2011). The organizing vision for cloud computing in Taiwan. *Journal of Electronic Commerce Research*, 12(4):257-271
32. Star, S. L., and Ruhleder, K. (1999). "Steps toward and ecology of infrastructure: design and access for large information spaces," *Information Systems Research* (7:1), March, pp. 111-134.
33. Strauss, A. and Corbin, J. (1998). Basis of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. 2nd edition. London: Sage.
34. Spencer J., Murtha T. & Lenway S. (2005). "How governments matter to new industry creation." *Academy of Management Review, 30:* 321-337
35. Tucker L. (2009), Introduction to cloud computing for Startups and Developers, Sun Microsystems, Inc.
36. Tilson, D., Lyytinen, K. and Baxter, R. (2004). A framework for selecting a location based service (LBS) strategy and service portfolio, in the Proceedings of the Hawaii International Conference on System Sciences.
37. Vouk, M., Sills, E. and Dreher, P. (2010). Integration of High-Performance Computing into Cloud Computing Services. In Furht, B., ed. : *Handbook of Cloud Computing*. Springer pp.255-276.

38. Walsham, G. (1997). Actor Network Theory and IS Research: Current status and future prospects, in A.S. Lee, J. Liebenau and J.I. DeGross (eds.) *Information Systems and Qualitative Research*, London: Chapman & Hall pp.466–480.
39. Walsham, G. and Sahay, S. (1999), "GIS for district-level administration in india: problems and opportunities", *MIS Quarterly* 23 (1): 39-66.
40. Weinhardt, C., Anadasivam A., Blau B., Borissov N., Meinl T., Michalk W., and Stößer J. (2009). "Cloud computing—A classification, business models, and research directions," *Business & Information Systems Engineering* 1 (5):391-399.
41. Wei F. (2009). Research on the application of cloud computing on the internet. *Computer Knowledge and Technology* 5(3):583-584, 670
42. Yin, R. K. (1994). Case study research: Design and methods (2nd ed.). Newbury Park, CA: Sage.
43. Zott C. and Amit R. (2008). The fit between product market strategy and business model: implications for firm performance, *Strategic Management Journal* 29: 1-26

APPENDIX

Interviewee

	affiliation	position	Actor categories
1	China HP	Managing Director and Vice President of Global Sales.	System providers
2	Intel Corporation	Director of infrastructure, Enterprise and Word Ahead Organization	System providers
3	Microsoft corporation	General Manager of Marketing and Operations Chief Cloud Officer	System providers
4	Microsoft corporation	Global Vice President of Technology Policy	System/Service providers
5	Cisco System, Inc.	Vice President of Cisco China	System providers
6	AMD corporation	Vice president	System providers
7	Chongqing Economic and Information Commission	Director	Government
8	China Academy of Telecommunication Research of MIIT	Vice President	Government agency
9	China Telecom	Senior Manager of Beijing Branch	Service providers
10	China Mobile	Assistant president of the central institute	Service providers
11	China Mobile	Senior Manager of the cloud computing	Service providers
12	China Unicom	Senior Manager of Broadband Department	Service providers
13	China Unicom	Vice president of the central institute	Service providers
14	Lenovo	Vice president of the central institute	System providers
15	Alibaba corporation	Senior Manager of Research institute	Service providers
16	Shanghai Government	Vice director of planning and development committee	Government
17	Wuxi Government, Jiangsu Province	Director of IT &Computing	Government
18	Chongqing Government	Vice director of	Government

	affiliation	position	Actor categories
		informationalization and industrialization	
19	MIIT	Vice director of technology department	Government
20	MIIT	Chief Engineer of Research institute	Government
21	ZTE corporation	Vice president of cloud computing	System providers
22	Huawei Technologies	Deputy director of Technology department	System providers
23	Chinese Academy of Sciences	Vice Department Director of Center of Network	Research institutes
24	NDRC	Vice Division Director of Department of High-tech	Government
25	Information Committee of Beijing	Department Director	Government
26	Shanghai Supercomputing Center	Vice Director	Service providers
27	Beijing Supercomputing Center	Director	Service providers
28	Institute of Computing, Chinese Academy of Sciences	Research professor	Research institutes
29	Institute of Computing, Chinese Academy of Sciences	Vice President	Research institutes
30	Intel China	Senior manager for cloud computing	System providers
31	NSFC	Department Director of Information Department	Government agency

(The summary of interviews with names of interviewees ambiguous by request)

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

INTER-ORGANIZATIONAL RELATIONSHIP AND INNOVATION PERFORMANCE IN ELECTRONIC SUPPLY CHAINS

Jao-Hong Cheng, Department of Information Management, National Yunlin University of Science and Technology, Douliou, Taiwan

Chih-Ming Lee, Department of Information Management, National Yunlin University of Science and Technology, Douliou, Taiwan

Mu-Chung Chen, epartment of Information Management, National Yunlin University of Science and Technology, Douliou, Taiwan

ABSTRACT

Purpose - *To address this important issue in supply chains, this paper presents a research model to examine the factors influencing the innovation performance and implementation in electronic supply chains.*
Methodology– *We analyze data collected from 252 of the top 1000 Taiwanese manufacturing firms in 2011 listed by Business Weekly. Our research model comprises two research hypotheses with three constructs, including institutional orientation, relational benefits and innovation performance. The hypotheses are tested via an empirical study of electronic supply chains.*
Findings - *The findings demonstrate that electronic supply chain members should reinforce their relational benefits and institutional view of relational governance so as to improve their innovation performance for achieving competitive advantage of electronic supply chains*
Value - *Our results show that relational benefits improving the positive effect of institutional orientation on innovation performance.*

Keywords: institutional orientation, relational benefits, innovation performance

INTRODUCTION

Inter-organizational relationships are established, maintained and enhanced to achieve competitive advantages for all parties involved (Cheng, 2011). In an electronic supply chain, different types of relationships are formed based on the type of collaboration, from close collaborative product development to simple buy-and-sell interaction. A supplier partnership in the electronic supply chains implies the agreement between a manufacturing firm and its suppliers or subcontractors. It includes sharing risks and benefits that come along with the relationship. The buyer-seller relationships, for its part, reflect strategic relationships among independent firms. Both partners in a relationship tend to collaborate together if they perceive cooperation with each other will bring benefits or value.

Inter-organizational innovation performance has increasingly become key determinants of electronic supply chains' competitive advantages (Wang, Yeung, and Zhang 2011). The performance of an organization in inter-organizational relationships such as electronic supply chains for achieving its business goals often depends on the innovation performance that it develops and implements with its partners (Azadegan 2011). Inter-organizational innovation performance within an electronic supply chain has thus become a common practice, because it enhances the competitive advantage of the electronic supply chain as a whole.

To take full advantage of innovation performance, manufacturers must understand the factors influencing inter-organizational innovation performance. Existing research on this important issue has paid little attention to the causes of the innovation performance in an inter-organizational context (Petersen, Handfield, and Ragatz 2005; Wang, Yeung, and Zhang 2011). In particular, no study has examined how the interactive factors of inter-organizational relationships affect innovation performance and these relationships. To achieve the benefits of inter-organizational innovation performance, it is important in the maintenance of good relationships.

To verify this new research model, we first examine how the institutional orientation of a company affects its attitude toward inter-organizational innovation performance. Then, we look into how factors of relational and institutional view affect the connection between institutional orientation and inter-organizational innovation performance. Specifically, we examine how relational benefits affect the interaction between institutional orientation and innovation performance.

In the following sections, Section 2 presents theoretical framework and hypothesis development. The data collection method and research design are described in Section 3, and the study findings are presented in Section 4. Finally, Section 5 provides a discussion of the results, and Section 6 concludes the paper and offers directions for future research.

THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

Institutional Orientation

In an electronic supply chain, a strong institutional orientation means that the willingness of a firm to build and to maintain positive relationships with its partners is enhanced (Dwyer, Schurr, and Oh 1987; McFarland, Bloodgood, and Payan 2008). The firm will choose to conform to the "rules of the game" to avoid being locked out of cooperative relationships

and to ensure access to relational resources (DiMaggio and Powell 1983; Tolbert 1985; North 1990; Liang *et al.* 2007; Cheng 2011). With collaborations between partners will boost the innovation performance (Wang, Yeung, and Zhang 2011). Thus, it is reasonable to propose that the higher the institutional orientation between partners improve inter-organizational innovation performance. It is thus hypothesized that:

Hypothesis 1: Institutional orientation is positively related to innovation performance

Relational Benefit

The critical role of relational benefits is always a top priority when a company decides whether or not to form partnerships with others. They are crucial in determining the level of commitment to product profitability, customer satisfaction, and market share. Similarly, when the relational benefits provided by one company are greater than those provided by others, customer loyalty improves. The willingness of customers to build and maintain long and positive relationships with the company is subsequently enhanced (Gwinner, Gremler, and Bitner 1998). Therefore, relational benefits between partners are so substantial that can affect relationship effectiveness in electronic supply chains. Thus, the higher the relational benefits between partners increase the effect of institutional orientation on innovation performance. Therefore, It is hypothesized that:

Hypothesis 2: The association between institutional orientation and innovation performance is moderated by relational benefits such that the association is significantly stronger when a high level of relational benefits is present.

RESEARCH METHOD

To develop the survey instrument, pools of items are identifies from this literature in order to measure the constructs of this research model. All measures of this survey instrument were developed from the literature. The expressions of these items are adjusted, where appropriate, to the context of marine transportation logistics. The items measured on a seven-point Likert scale, ranging from ‘strongly disagree’ (1) to ‘strongly agree’ (7).

In order to improve content and appearance of the 12-item questionnaire, a pre-test of it was performed on a sample comprising three academic researchers and five Ph.D. Students. The empirical study aims at top 1000 manufactory enterprises selected from directories of 2011 Business Weekly top 1000 firms in Taiwan. This resulted in 252 effective responses and a

total response rate of 25.2%. A Chi-square analysis of the industry distribution of the respondents showed no difference from the industry distribution of all the firms used in the survey. This suggested no non-response bias in the returned questionnaires.

RESEARCH RESULTS

Structural equation modeling (SEM) with LISREL 8.54 (Joreskog and Sorbom 1993) was used to test and analyze the hypothesized relationships of the research model. SEM aims to simultaneously examine the inter-related relationships among a set of posited constructs, with each construct being measured by one or more observed item(s) (measures). SEM involves the analysis of two models: a measurement (or confirmatory factor analysis) model and a structural model (Anderson and Gerbing 1988). The measurement model specifies the relationships between the observed measures and their underlying constructs, which allowed to inter-correlate, and the structural model specifies the posited causal relationships among the constructs.

Institutional orientation is positively associated with innovation performance. relational benefits is positively associated with the effect of institutional orientation on innovation performance. The overall fit of the structural model is acceptable, since all measures of fit reach an acceptable level (χ^2 = 209.128, df = 112, $p < 0.01$; GFI = 0.911; AGFI = 0.862; CFI = 0.915; NFI =0.909; RMSEA=0.046). The result shows that institutional orientation (H1: γ = 0.182, t = 3.902, p < 0.001) is significantly associated with innovation performance, and its interactions with relational benefits (H2: γ = 0.421, t = 4.018, p < 0.001) is significantly associated with innovation performance.

DISCUSSION AND CONCLUSION

Conforming to the hypothesis, institutional orientation has the strongest positive influence on inter-organizational innovation performance. This finding is consistent with Bello, Lohtia, and Sangtani (2004). In Taiwan's electronic supply chains, this factor plays the most significant role in undermining inter-organizational innovation performance. Institutional orientation means there are formally through rules or laws, or informally through certain cultural expectations between electronic supply chain members. Violating these rules may bring a firm's legitimacy into question and jeopardize its access to scarce resources and social support (DiMaggio and Powell 1983; Tolbert 1985; Liang *et al.* 2007). Thus, institutional orientation can impact partners' ability to process rationalize, and exercise discretion in inter-organizational innovation performance.

We also find that the association between institutional orientation and innovation performance is positively moderated by relational benefits, consistent with the finding of Petersen, Handfield, and Ragatz (2005) and Wang, Yeung, and Zhang (2011) that a good relationship increases inter-organizational innovation performance. It is not surprising that relational benefits constitute the greatest contributing factor, and, not unexpectedly, a Taiwan's manufacturing firms will form inter-organizational relationships only when it can benefit from the relationship. For example, one party from the cooperation relationship could be the net-gainer at any one time. Therefore, there would be no cut-and-run because the party perceives that only through continuity of collaboration can gains be achieved in the future (Dodgson 1993). This indicates that organizations tend to collaborate together if they perceive cooperation with each other will bring benefits and good performance.

It is of strategic importance for an organization to understand the factors influencing the performance of innovation developed and implemented with its partners in an inter-organizational relationship such as electronic supply chains. In this study, we find that the institutional orientation is positively associated with innovation performance. We also find that relational benefits between electronic supply chain members increase the willingness of partners to enhance their relationships to improve the performance of innovation. When both sides in an electronic supply chain perceive cooperation with each other will bring benefits, organizations tend to increase the closeness of the relationship. The findings of the study provide practical insights in understanding how enhanced inter-organizational relationship benefits can help enhance inter-organizational innovation performance.

ACKNOWLEDGEMENTS

This research was supported by the National Science Council of Taiwan, ROC, under Contract NSC 99-2410-H-224-010-MY3.

REFERENCES

1. Anderson, J.C. and D.W. Gerbing. (1988) 'Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach,' *Psychological Bulletin*, (103:3), pp. 411-423.
2. Azadegan, A., K. (2011) 'Benefiting from Supplier Operational Innovativeness: The Influence of Supplier Evaluations and Absorptive Capacity,' *Journal of Supply Chain Management,* (47:2), pp.49-64.
3. Bello, D. C., R. Lohtia and V. Sangtani. (2004) 'An Institutional Analysis of Supply

Chain Innovations in Global Marketing Channels,' *Industrial Marketing Management*, (33:1), pp.57-64.

4. Cheng, J.H. (2011) 'Inter-Organizational Relationships and Information Sharing in Supply Chains,' *International Journal of Information Management,* (31:4), pp.374-384.
5. DiMaggio, P. and W. W. Powell. (1983) 'The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields,' *American Sociological Review*, (48:2), pp.147-160.
6. Dodgson, M. (1993) 'Learning Trust and Technological Collaboration,' *Human Relations,* (46:1)*,* pp.77-95.
7. Dwyer, F.R., P.H. Schurr and S. Oh. (1987) 'Developing Buyer-Seller Relationships,' *Journal of Marketing*, (51:2), pp.11-27.
8. Gwinner, K.P., D.D. Gremler and M.J. Bitner. (1998) 'Relational Benefits in Services Industries: The Customer's Perspective,' *Journal of the Academy of Marketing Science*, (26:2), pp.101-114.
9. Joreskog, K.G. and D. Sorbom. (1993) *LISREL 8: Structural Equation Modeling with The SIMPLIS Command Language*. Scientific Software International, Chicago
10. Liang, H., N. Saraf, Q. Hu and Y. Xue. (2007) 'Assimilation of Enterprise Systems: The Effect of Institutional Pressures and The Mediating Role of Top Management,' *MIS Quarterly,* (31:1), pp.59-87.
11. McFarland, R. G., J. M. Bloodgood and J. M. Payan. (2008) 'Supply Chain Contagion,' *Journal of Marketing*, (72:2), pp.63-79.
12. North, D. (1990) *Institutions, Institutional Change and Economic Performance*, Cambridge: Cambridge University Press
13. Petersen, K. J., R. B. Handfield and G. L. Ragatz. (2005) 'Supplier Integration into New Product Development: Coordinating Product, Process and Supply Chain Design,' *Journal of Operations Management*, (23:3-4), pp.371-388.
14. Tolbert, P. S. (1985) 'Institutional Environments and Resource Dependence: Sources of Administrative Structure in Institutions of Higher Education,' *Administrative Science Quarterly*, (30:1), pp.1-13.
15. Wang, L., J. H. Y. Yeung and M. Zhang. (2011) 'The Impact of Trust and Contract on Innovation Performance: The Moderating Role of Environmental Uncertainty,' *International Journal of Production Economics*, (134:1), pp.114-122.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

E-BUSINESS ANALYSIS OF REAL ESTATE COMPANIES

Delvin Grant, DePaul University, USA
Email: dgrant2@depaul.edu

Emna Cherif, DePaul University, USA
Email: emcherif@gmail.com

ABSTRACT

We analyzed the e-business websites of Realestate.yahoo.com, Realtor.com, and Zillow.com. We looked at the similarities and differences between them and how e-business components help differentiate one company from another and the role this plays in contributing to their success. We looked at which business model components, such as value proposition, target customers, distribution channels, and revenue streams, are important. The type of e-business models each company used and the ones that are more successful were investigated. We discovered some similarities and differences; some differences were the use of revenue streams for generating multiple sources of revenue, the type of e-business models used and the role they play in executing the e-business strategy.

Keywords: Canvas Framework, Real Estate, Business Models, e-business, Analysis

INTRODUCTION

The internet's ability to provide access to information has improved real estate communications and business (Aalberts and Townsend, 2002). Business models represent the business logic of companies. They are executed by company websites and are important to the success of companies. E-business models represent the rationale of how companies create, deliver, and capture value (Linder and Cantrell, 2000). By understanding them, companies identify opportunities to improve the business (Osterwalder, 2004), so it is important to understand their role. The internet has changed the real estate business but the importance of e-business could be further developed Our principal research objective is to investigate the role that e-business models play in real estate. In pursuit of this objective, we look at the similarities and differences among e-business models and how they affect company success. We investigate the importance of four business model components--value proposition, target customer, distribution channel, and revenue streams--using Canvas Framework (Osterwalder, 2010). We also looked at the type of e-business models used by each company. The contributions of this work are 1) identification of the components of e-business models of industry leaders, which serve as benchmarks for competitors; 2) demonstrating that the use of e-business model components helps companies understand which ones contribute to company success; 3) elucidating the role that e-business components play in attracting customers; and 4) helping companies understand which type of e-business models works best.

The paper is organized as follows. Section 2 reviews definitions of e-business models, section 3 defines the types of e-business models and section 4 analyzes three e-business models. The paper ends with a discussion in section 5.

E-BUSINESS MODEL DEFINITIONS

The internet has enabled new ways to deliver customer value by using e-business models that change how companies operate. E-business enables traditional businesses to evolve to a hybrid brick-and-mortar/online model. E-business is an approach to expand traditional business models, increase markets, and grow revenue. Several definitions of e-business exist (Cagnina and Poian, 2009; Rappa, 2004; Osterwalder, 2010; Methlie and Pedersen, 2007). Timmers (1998) defines eleven generic e-business models, from e-shops and e-procurement to trust and other third-party services. Tapscott et al. (2000) propose a network-and-value-centered taxonomy with five types of value networks called "business webs," which differ in their degree of economic control and value integration. Weill et al. (2001) describe eight so-called "atomic" e-business models; each describes different ways of conducting business electronically. E-business initiatives are represented by pure atomic business models or by combining them. Applegate (2001) introduces six e-business models: focused distributors, portals, producers, infrastructure distributors, infrastructure portals, and infrastructure producers. Dubosson-Torbay et al. (2002) identify the principal dimensions--user's role, interaction pattern, nature of the offering, pricing system, level of customization, and economic control--for classifying e-business models. Rappa (2001) describes companies by their value proposition and ways of generating revenue. His classification has nine categories of e-business models: brokerage model, advertising model, infomediary model, merchant model, manufacturer model, affiliate model, community model, subscription model and utility model.

E-business models are comprised of a set of components so we need to choose the appropriate application framework to define the relationship between them. The growth of e-business has raised interest in transforming traditional business models to exploit opportunities through innovation (Pateli and Giaglis, 2003). The internet has changed the idea of a business model and this has practical implications for companies. Consequently, companies need to redefine customer value propositions, and their business model. Enhancing customer experience helps to reshape customer value propositions (Berman and Bell, 2011). Creating new digital capabilities helps to refine the operating model by leveraging information to manage organizations, and integrating and optimizing digital and physical components (Berman and Bell, 2011). Effective use of e-business models depends on the economic environment, market and industry conditions, and the internal and external factors of organizations. Internal and external factors affect the need for business model change. Internal functions include product/service innovation, performance and the availability of resources (Giesen, et al., 2009). Product and service innovation is a key driver of new e-business models, especially for companies introducing to the market new products or services that require new skills, and capabilities and processes that lead to new value propositions.

Financial performance and the availability of key resources are both drivers and enablers of business model innovation. For the e-business real estate industry, introducing new services such as mobile device applications and online property value analysis are considered internal factors. External factors include new entrants, competitors, customer preferences, customer segments, technology, regulatory/legal, and the business environment. When customer preferences for goods and services change, they force changes to the customer value proposition and the e-business model.

TYPES OF E-BUSINESS MODELS

There are four primary types of e-business models: web-advertising model, brokerage business model, virtual value-chain model and the diversified model. Web-advertising is an extension of the traditional media broadcast model where the broadcaster is a website that provides free content and services such as email, IM, and blogs, mixed with advertising messages in the form of banner ads. One of the most sophisticated forms of internet advertising is Google ad. Banner ads are a major source of revenue for broadcasters. The website platform is designed to attract users with free content, products, or services; it generates revenue by selling space to advertisers and is a popular and rapidly growing advertising model (Jansen and Schuster, 2001; Jansen and Mullen, 2008). Realestate.yahoo.com, Realtor.com, and Zillow.com use this model. The brokerage model brings brokers, sellers, and buyers together to do business. The broker charges a fee to at least one party involved in the transaction. Brokers connect consumers with retailers, businesses with each other and consumers with each other. In real estate, e-business companies enable the search for properties and provide brokerage services. Companies that use the brokerage model make money from commissions and service fees. The payment of commissions to brokerages is contingent upon finding satisfactory buyers, successful negotiations of purchase contracts between buyers and sellers, the settlement of transactions, and the exchange of monies between buyers and sellers. In this model, the median commission charged to sellers by listing agents is 6% of the purchase price and is shared between sellers. The virtual value-chain supports the traditional value chain and it has changed the way businesses operate (Rayport and Sviokla, 1995). The traditional value chain uses information for support but the virtual value-chain uses information as a value-creating opportunity where products and services are in the form of digital information delivered through information-based channels. The three sites under study use that model. The diversified model helps companies to expand their core business to related products and services. In this model, a parent company owns the network and the diversified model provides internally integrated product-service mix. The model has several merits, one of which is that it enables companies to reduce reliance on core products and spread their risk by moving into other markets and offering combined product-service packages. It offers opportunities to develop powerful brands and to acquire better corporate image. One drawback is that it requires more investment in new technology, as well as major cultural changes for providing diversified product/services instead of a single product/service. Diversifying the business introduces additional risks and this may explain why it is not used by any of the three sites.

ANALYSIS OF E-BUSINESS MODELS

We compare the business models of the top three e-business sites using Canvas Framework. We determined the popularity of the sites by the amount of business they generate and the percentage of visitors they attract (Top 20 real estate websites, 2012). We selected the sites because of their popularity and position in the industry (Ebiz/mba, 2012). They are representative of real estate sites that exhibit the core services such as mobile applications, advanced property searches, map interfaces, home alerts, demographics data, MLS listings, property listing prices, ability to contact agents, location searches, ability to save searches, advice forums, new property listings, and property value analysis. The sample includes sites that use web-advertising, virtual value-chain, or the brokerage model. Realtor.com has the ability to list properties worldwide.

The data in table 1 were collected in several ways. First, we performed online feature analysis of three sites by logging into them to discover the various features available to users and to assess their capability and user friendliness. Second, we analyzed business and technical reports (Zillow.com, 2012).

Table 1: Business Models Comparison

	Zillow.com	**Realtor.com**	**Realestate.yahoo.com Yahoo.com**
Value Propo-sition	**Newness**: The users have the possibility to appraise the property values based on undisclosed factors using a proprietary algorithm called the "Zestimate."	**Newness:** DocuSign, the electronic signature provider, makes available DocuSign for Realtors. Realtor.com launched the international version of the web site.	**Newness:** Realestate.yahoo.com Yahoo real estate displays predominantly on the home page the user location once the client visits the website.
	Usability & Performance of Services: Zillow Mobile applications are easy to use and provide real estate data and information to users quickly and efficiently.	**Usability & Performance** Realtor.com makes ongoing and frequent changes to improve its performance.	**Usability & Performance** The Yahoo real estate website actual search process is simple and straightforward.

	Zillow.com	Realtor.com	Realestate.yahoo.com Yahoo.com
	Customization: This website provides these features: establish an account, login, MLS listing, listing price, find an agent, location aware search, saved search, advanced search, advice forum, new listing, mobile device application, home alerts, value analytics, map interface and demographics.	**Customization:** This website provides these features: establish an account, login, MLS listing, listing price, find an agent, location aware search, saved search, advanced search, advice forum, new listing, mobile device application, home alerts, map interface.	**Customization:** This website provides these features: establish an account, login, MLS listing, listing price, find an agent, location aware search, saved search, advanced search, advice forum, new listing, home alerts, value analytics, map interface and demographics. Realestate.yahoo.com Yahoo real estate does not have the mobile device application.
	Design: The website has superior design.	**Design:** The website has superior design.	**Design:** The website has superior design.
Target customer	Buyers, sellers and house owners. Brokers, agents and bank.	Buyers, sellers, house owners, brokers, agents and bank.	Buyers, sellers, house owners, brokers, agents and bank.
Distribu-tion channel	Web sale, advertisement on other Web sites, newspapers.	Web sale, advertisement on other Web sites, newspapers.	Web sale, advertisement on other Web sites, newspapers.
Relation-ship	**Personal services**: agents, brokers and lenders advertising.	**Personal services:** NAR members, buyers, sellers.	**Personal services:** Lenders, buyers and sellers forums.
	Automated services: The users can access the customized services.	**Automated services:** The users can access the customized services.	**Automated services**: The users can access the customized services.

	Zillow.com	Realtor.com	Realestate.yahoo.com Yahoo.com
Value configuration	**Platform/ Network:** The website continually improves. The company improved the Zestimate algorithm precision.	**Platform/ Network:** Realtor.com website continually improves. It has extended to Realtor.com International web site.	**Platform/ Network:** The website continually improves. The company has also introduced a range of new features for real estate professionals.
Capability	**Physical resources:** Partner network.	**Physical resources:** Partner network.	**Physical resources:** Partner network.
		Human resources: NAR members.	
Partnership	**Acquisition of particular resources and activities:** YahooReal Estate: partnership. Zillow Mortgage Marketplace has Distribution Partnership with Redfin.Mortgage Concepts, LLC. AmeriSave partnership.	**Acquisition of particular resources and activities:** The National Association of Realtors launched a partnership with Olinger Group.	**Acquisition of particular resources and activities:** Yahoo Real Estate and Zillow have entered into a partnership that will place targeted ads that real estate agents and brokers purchase from Zillow in property search results on both sites.
Revenue Streams	**Advertising:** The website makes money from broker, agent and bank ads.	**Advertising:** The realtor pays monthly fees to Realtor.com to get his/her name to show up on top 10% of the time in a rotation.	**Advertising**: Yahoo real estate sells display advertising on the website to new home builders, real estate agents and brokers. Yahoo has advertising partnership with Zillow; all showcase ads and featured listings ads purchased through Zillow will automatically appear on both Zillow and Yahoo Real Estate.

	Zillow.com	Realtor.com	Realestate.yahoo.com Yahoo.com
		Brokerage: The revenue of this website relies on the percentage of the transaction commission for generating leads.	
Cost structure	Platform development & management	Platform development & management	Platform development & management

The newness dimension of the value proposition component is widely used by the sites. Zillow.com has a new and interesting property estimate algorithm called Zestimate which provides Zillow users with home value estimates that are calculated on a range of publicly available information, including sales of comparable houses in a neighborhood. The new feature for Realtor.com is DocuSign, allowing National Association of Realtors (NAR) members to sign documents anytime, anywhere on any device using the DocuSign for Realtors for free with unlimited signers and unlimited file storage. The NAR launched the Realtor.com International web site, which makes available to buyers across the globe millions of for-sale property listings on Realtor.com. Third party content providers feed residential property data to sites. For Realestate.yahoo.com, the new feature is the capability to display the users' location on the website. Regarding usability and performance dimension of the value proposition, the mobile device application in Zillow.com is helpful and user friendly. The elegance of the graphical user interface is helpful, and provides data and information quickly and efficiently. Search result pages have average sales prices in each city and provide a list of buyer agents and a button to call them directly. Realtor.com continues to improve lead capture, increase exposure for company and listings, and improve the overall web site experience for real estate buyers and sellers. Realestate.yahoo.com offers an easy home search service and useful tools that provide easy access to millions of property listings, a mortgage calculator, and market snapshot information. Regarding the customization dimension of the value proposition, internet sites offer a bundle of services to users that are provided by third-party providers. This shows that internet sites may use virtual value-chain business models.

Realtor.com has a mobile application that has different usage modes. The Realtor.com iPad app allows consumers to communicate with company realtors via the internet. Realestate.yahoo.com does not have a mobile device application. Regarding the website design dimension of the value proposition, the Mobile Widget of Realtor.com is slated to be removed. The Real Estate News and Advice will be temporarily removed and the number of searchable neighborhoods on Realtor.com will increase significantly. In comparison, Zillow.com and Realestate.yahoo.com have elegant designs compared to Realtor.com. The target customer component is identical for all the sites and includes buyers, sellers, house owners, brokers, agents, and banks. Regarding the distribution channel component, websites enable communication with customers to deliver value propositions, such as sales, and online advertisements. Regarding the advertising dimension of

the revenue stream component, some websites use the web-advertising model to make money from agents, brokers and mortgage bank ads. Agents and brokers buy local advertisements and they pay to display property listings and contact information such as agent name, property address, and property price. The three sites use a web-advertising strategy. Zillow.com generates revenue by selling advertising and which enables Zillow to offer free service to users. The revenue is used to build new internet services. Zillow also enables brokers and agents to purchase featured listings that appear by default at the top of a customer's property search results. It allows agents and brokers to purchase showcase ads in desired ZIP codes. Zillow's current mobile platform provides opportunities to deliver value to advertisers through its location-based advertising options. Realtor.com, affiliated with the National Association of Realtors, enables agents to buy advertising on the spot. Agents have various options to market featured homes to affluent clients or to advertise their services in banner ads based on locality. Pricing for realtors who choose to enhance their property and personal advertising is based on the advertising industry standard, the cost per thousand consumers reached by the advertisement. Advertising on the site is subject to tight controls, including ads from other realtors. Regarding the paid subscription dimension of the revenue stream component, the partnership between Realestate.yahoo.com and Zillow.com creates the largest real estate network on the internet, enabling real estate agents to advertise locally on Yahoo. Homebuyers have access to more local listings on Yahoo Real Estate, along with more photographs. Zillow serves as the exclusive provider of for-sale property listings information on Yahoo Real Estate. Yahoo will continue to control the appearance of for-sale listings and maintain separate databases for foreclosures, newly constructed homes, and rentals. It's not the first time Realestate.yahoo.com has partnered with other companies to provide for-sale property listings content. Yahoo and Prudential Real Estate entered into an exclusive agreement in 2004 for Prudential to provide for-sale listings information, but that arrangement ended in 2008.

CONCLUSION

For companies to change, improve, and innovate e-business models, they must understand them. To aid this understanding, we analyzed the top three e-business models of Zillow.com, Realtor.com, and Realestate.yahoo.com. The analysis includes the value proposition, target customer, distribution channels, and revenue stream e-business components. Canvas Framework consists of nine components but we focused on four due to the paper restrictions. The e-business models of the three companies exhibit similarities, differences, and common features. Similarities include online searches of real property, ability to contact agents and list real property, ability to target sellers, buyers, and agents, ability to advertise, enable personal and automated services, and establish relationships with business partners. The target customer is similar across the three companies and distribution channels are identical. Companies add new features and services to attract customers by differentiating themselves from competitors. Differences exist with regard to the newness feature of the value proposition. Zillow's new service, the ability to perform online property appraisal, increases efficiency, provides convenience, and increases the value proposition of customers. Traditional property appraisal is time consuming and inconvenient as customers have to identify appraisers, schedule appraisal appointments, and be available for the appraisal. This delays the buying and selling of properties and reduces product turnover and revenue. Real estate transactions require in-person signatures

so Realtor enables electronic signatures, a value added service for customers. Estimating property values requires agents who compare the target property to similar properties in the neighborhood. More revenue streams leads to increased revenues so companies with single income streams benefit from acquiring new streams of income. We found that e-business model differentiation plays an important role in the success of companies. Various distribution channels are used to reach customers. The resources used to reach, create and deliver value to customers are a combination of products, services and technologies including mobile applications. A major factor in creating value for customers is through the convenient access to information and services related to real estate. This includes access to agents, property information, location data, access to financiers, and mortgage analysis. Companies that combine the advertising and the value-chain model rank higher (Top 20 real estate websites, 2012).

Studies indicate that Realestate.yahoo.com, Realtor.com, and Zillow battle for the leadership position in the industry (Inman news, 2012; Property Portal Watch, 2011). In 2011, Realestate.yahoo was rated number one in market share while Realtor was number two, but in June 2012, Zillow was number one. All three sites have no paid subscriptions, do not rely on brokers and agents, and do not use brokerage except for Realtor. This suggests that the absence of paid subscriptions, brokers, agents, and brokerage do not significantly affect company performance, since the top contender in 2011 and 2012 had none. Based on our study, a successful e-business model does not have to include them all. The top three performing sites Realestate.yahoo.com, Realtor.com, and Zillow.com use the web-advertising model, which is the most successful model with respect to market share and revenue. In addition to using the web-advertising model, Realtor.com uses the brokerage model. Given that Zillow and Realestate.yahoo do not use the brokerage model suggests that it does not lead to competitive advantage. The three companies use the virtual value-chain, as many products and services are digitized and available online. The use of the internet implies the use of the value-chain model. None of the three sites uses the diversified business model. The three sites use hybrid internet models. The Realtor.com e-business model uses web-advertising, brokerage, and virtual value-chain while Zillow and Yahoo use web-advertising and the virtual value-chain.

The adoption and the development of e-business models do matter with respect to the various types of enterprises such as public agencies, for-profit private or public firms, and SMEs. Real estate companies are considered for-profit firms that are privately or publicly owned and would be classified as small, medium enterprises (SMEs). Public agencies differ significantly from private or public firms in their mission and objectives. Public agencies focus primarily on the social good and are seldom motivated by profit. However, for-profit firms are motivated by profit since they have an obligation to create shareholder wealth. Therefore, the type of e-business model companies develop or adopt should be congruent with the company mission and objectives. Our study indicates that the web-advertising model is appropriate for generating revenue and companies that are motivated by maximizing revenue and profit prefer it. It should not matter if the company is a for-profit private or public firm or a SME but it does matter if it is a public agency. Public agencies that are not motivated by maximizing profit tend to emphasize the sharing of services and information, to improve the social good of communities. Public agencies would consider the virtual value-chain or the diversified model appropriate choices. The virtual value-chain model is ideal for extending the enterprise beyond the confines of brick

and mortar by providing services and information to a much larger audience. The diversified model is ideal for public agencies that seek to leverage the synergies that exist among various product and service offerings. Therefore, Federal, local and not-for-profit agencies may find the diversified model useful. In some situations, it may be viable to develop or adopt a hybrid e-business model that combines the virtual value-chain and the diversified model. This decision will depend on the mission and objectives that companies seek to fulfill. If they seek to exploit the natural synergies that exist among various products and services while targeting a larger audience, then we recommend a hybrid model.

This study is valuable because it identifies some of the primary components of e-business models, which help competitors assess the similarities and differences between e-business model components. The assessment elucidates the strengths and weaknesses of e-business models, which help companies to improve performance and customer experience. E-business models help in the execution of business strategy and are extensions of the traditional business, so this information is useful to alignment the e-business model with the business strategy. By understanding the important components of e-business models, companies are equipped to focus on specific components. Since the real estate industry is experiencing hardship, knowledge and insight gained from this work help companies improve their competitiveness.

This research has several limitations. First, the page restriction forced us to ignore five e-business components. We also ignored some dimensions of the four components we discussed. For example, we ignored the information brokerage dimension of the revenue stream component and several dimensions of the value proposition, so a larger study should include them. It would be interesting to see how their inclusion changes the findings. Canvas Framework does not emphasize model management, continuous improvement, or business model governance, so we recommend expanding the study to include them. We recommend expanding the number of e-business websites to further investigate new findings.

REFERENCES

1. Aalberts, R., and Townsend, A., (2002), Real Estate Transactions, the Internet and Personal Jurisdiction, Journal of Real Estate Literature, Vol. 10, No. 1, pp. 27-44.
2. Applegate, L., (2001), Merging e-Business Models: Lessons From the Field, HBS No. 9-801-172. Boston, MA: Harvard Business School.
3. Berman, S., and Bell, R., (2011), Digital Transformation: Creating new business models where digital meets physical. http://www-935.ibm.com/services/us/gbs/thoughtleadership/ibv-digital-transformation.html.
4. Cagnina, M., and Poian, M., (2009), Beyond e-business models: to road to virtual worlds. Electronic Commerce Research, Vol. 9, No 1/2, pp. 49-75.
5. Clareity.com, (2010), The consumer smart phone revolution: Review of Real Estate Mobile Applications for the Consumer, http://www.callclareity.com/review-of-real-estate-mobile-applications-for-the-consumer-2010.pdf.
6. Dubosson-Torbay, M., Osterwalder, A., and Pigneur, Y., (2002), E-Business Model Design, Classification, and Measurements. Thunderbird International Business Review, Vol. 44, No. 1, pp. 5-23.
7. Ebiz/mba (2012), http://www.ebizmba.com/articles/real-estate-websites.
8. Giesen, E., Riddleberger, E., and Christmer, R., (2009), Seizing the advantage: when and how to innovate your business model. http://www-935.ibm.com/services/us/gbs/bus/html/ibv-business-model-innovation.html.
9. Inman News (2012), http://www.inman.com/news/2012/07/24/top-20-real-estate-website-in-june.
10. Jansen, B., and Schuster, S., (2001), Bidding on the buying funnel for sponsored search and keyword advertising. Journal of Electronic Commerce Research, Vol. 12, No. 1, pp. 1-18.
11. Jansen, B., and Mullen, T., (2008), Sponsored search: An overview of the concept, history, and technology. International Journal of Electronic Business, Vol. 6, No. 2, pp. 114 – 131.
12. Linder, J., and Cantrell, S., (2000), Carved in water: Changing business model fluidity, Working Paper, Accenture Institute for Strategic Change.
13. Methlie, L., and Pedersen, P., (2007), Business model choices for value creation of mobile services, Journal of Policy Regulation and Strategy for Telecommunications, Vol. 9, No. 5, pp. 70-85.
14. Osterwalder, A., (2004), The Business Model Ontology - A Proposition in a Design Science Approach, PhD Thesis, Dissertation 173, University of Lausanne, Switzerland.
15. Osterwalder, A., and Pigneur, Y., (2010), Business Model Generation, http://www.businessmodelgeneration.com.
16. Pateli A., and Giaglis, G., (2003), A Framework for Understanding and Analyzing eBusiness Models, Proceedings of 16th Bled eCommerce Conference eTransformation, Bled, Slovenia, June 9–11.
17. Property Portal Watch, (2011), US Online Real Estate Market, http://www.propertyportalwatch.com/2011/07/us-online-real-estate-market/.
18. Rappa, M., (2001), Business Models on the Web: Managing the Digital Enterprise, http://www.digitalenterprise.org/models/models.html.

19. Rappa, M., (2004), The Utility Business Model and the Future of Computing Services. IBM Systems Journal, Vol. 43, No. 1, pp. 32-42.
20. Rayport J., and Sviokla J., (1995), Exploiting the Virtual Value Chain, Harvard Business Review, Vol. 73, No. 6, pp. 75-85.
21. Schubert, P., and Hampe, J., (2000), Mobile Communities: How viable are their business models? An exploratory investigation of the leisure industry, Electronic Commerce Research, Vol. 6, No. 1, pp. 103-121.
22. Stewart, D., and Zhao, Q., (2000), Internet Marketing, Business Models and Public Policy, Journal of Public Policy and Marketing, Vol. 19, pp. 287-296.
23. Timmers, P., (1998), Business Models for Electronic Markets, Electronic Markets, Vol. 8, No. 2, pp. 3-8.
24. Top 20 real estate websites in June, (2012), http://www.inman.com/news/2012/07/24/top-20-real-estate-websites-in-june
25. Weill, P., and Vitale, M., (2001), Place to space: Migrating to e-Business Models, Boston, MA: Harvard Business School Press.
26. Zillow.com, (2010), Zillow Reports Record First Quarter 2012 Results, http://investors.zillow.com/releasedetail.cfm?ReleaseID=669775.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

EXPLORING THE DYNAMIC INTERDEPENDENCE AMONG THE EAST ASIAN STOCK MARKETS

Suthawan Prukumpai[1], Lecturer, Kasetsart Business School, Kasetsart University, Thailand
Email: Suthawan.Pruk@gmail.com

Yuthana Sethapramote[2], School of Development Economics, National Institute of Development Administration, Thailand

ABSTRACT

Stock market interdependence has strong implication for risk diversification. Recent empirical evidence suggests that correlations between international stock markets increase during period of financial turmoil. This paper investigates the development of stock market integration in East Asia using Dynamic Conditional Correlation GARCH (DCC-GARCH) model of Engle (2002). Weekly data from January 1991 to December 2011 are used in this study. The results show that there are time-varying patterns in both volatility and correlation among the East Asian stock markets. Further, the significant evidence of positive trend in the cross-country conditional correlations is found. Particularly, such correlations increase during the periods of high market volatilities when risk diversification is needed most. These show that the East Asian stock markets are more integrated during the past decade. Therefore, regulators, prospect investors, and fund managers should pay attention in volatility transmission between markets together with the limitations of international diversification during financial crisis.

Keywords: Financial interdependence, East Asian Economies, DCC-GARCH.

INTRODUCTION

During the past few decades, the progress of financial liberalization has been intensifying around the world. Meanwhile, the concept of international diversification of investment in stock markets has spawned a considerable volume of scholarly literatures. Many research papers, e.g. Levy and Sarnat (1970), Solnik (1974), illustrated the diversification benefits derived from the low correlations among the international stock markets. However, once Erb, et al. (1994) and Longin and Solnik (1995) re-examined this issue, they found that the degree of cross-correlation in stock markets were remarkably varying over time. Some researches, e.g. Ang and Bekaert (2002), further found that correlations are intensifying during the period of recession.[3] Consequently, a growing body of literature specifically on the dynamic behavior of stock market interdependence

[1] Lecturer, Kasetsart Business School, Kasetsart University
Corresponding author's email: fbusswp@ku.ac.th.
[2]Assistant professor, School of Development Economics, National Institute of Development Administration
[3] See Goetzmann, et al. (2005) for review of literature and historical data on the benefits of international portfolio.

is emerging. Even though dynamic correlations in stock returns are well documented, the existing literatures mainly focus on stock markets in the OCED countries.

Therefore, in this paper, the financial interdependence among the East Asian stock markets is explored because of their increasing role in the global financial market. There are two objectives in this study. First, we explore the dynamic measurement of cross-countries correlation and compute the time-varying cross-countries correlations among the East Asia stock markets. The Dynamic Conditional Correlation (DCC) – GARCH model of Engle (2002) are used in this study followed recent studies, e.g. Jacob and Karagozoglu (2009), Gupta and Donleavy (2009), You and Daigler (2010), to measure dynamic behavior in cross-countries correlations. Second, we check for the presence of long-run trend in degree of these time-varying cross-country correlation series using the trend regressions.

The rest of this paper is organized as follows. The econometric methodology is presented in Section 2. Section 3 provides descriptive statistics while Section 4 reports the empirical results. The last section not only concludes the main findings but also discusses the policy implications.

ECONOMETRIC METHODOLOGY

In this paper, the DCC-GARCH model proposed by Engle (2002) is employed to generate time-varying correlation among the East Asian stock markets. This method follows the multivariate GARCH approach to estimate mean and variance equations for a set of variables using the system of equation. Therefore, conditional variance for each series and covariance between series can be estimated simultaneously. The estimation method of the DCC-GARCH model is briefly discussed as follows.

Let $\boldsymbol{y_t}$ is a vector of *n*-time series variables:$\boldsymbol{y_t} = [y_{1t} \dots y_{nt}]'$,$\boldsymbol{\mu}$is a vector of conditional mean of y_t:$\boldsymbol{\mu} = [\mu_1 \dots \mu_n]'$, and $\mathbf{u}_t$ represent shock variables that can be derived from residuals of mean equation. The mean equation is written as

$$\boldsymbol{y_t} = \boldsymbol{\mu} + \mathbf{u}_t. \tag{1}$$

And the matrix of conditional variance and covariance, $\mathbf{H}_t$, is then defined as:

$$\mathbf{H}_t = \mathbf{D}_t\mathbf{R}_t\mathbf{D}_t, \tag{2}$$

where $\mathbf{D}_t$ is a diagonal matrix of time-varying standard deviations estimated from univariate GARCH models and $\mathbf{R}_t$ is a matrix containing conditional correlation of $\mathbf{u}_t(\rho_{i,j,t})$. Therefore, the $\mathbf{D}_t$ matrix is defined as

$$\mathbf{D}_t = \mathrm{diag}\left(\mathrm{h}_{11,t}^{1/2} \ \dots \ \mathrm{h}_{nn,t}^{1/2}\right). \tag{3}$$

In this paper, the elements in $\mathbf{D}_t$ is set up as the univariate GARCH(1,1) processes as follow

$$h_{it} = \omega_i + \alpha_i u_{it-1}^2 + \beta_i h_{it-1}. \quad (4)$$

While the conditional correlation matrix, $\mathbf{R}_t$, which consists of the component of DCC structure, is constructed as

$$\mathbf{R}_t = \text{diag}\left(q_{11,t}^{\frac{1}{2}} \dots q_{nn,t}^{\frac{1}{2}}\right) \mathbf{Q}_t \text{diag}\left(q_{11,t}^{\frac{1}{2}} \dots q_{nn,t}^{\frac{1}{2}}\right), \quad (5)$$

where $\mathbf{Q_t}$ is the conditional variance-covariance variables for each series. Specifically,

$$\mathbf{Q_t} = (1 - a - b)\overline{\boldsymbol{Q}} + a\mathbf{u_{t-1}}\mathbf{u'_{t-1}} + b\mathbf{Q_{t-1}} \;;\; a + b < 1. \quad (6)$$

From above equations, the conditional variance ($q_{i,i,t}$) and covariance ($q_{i,j,t}$) series can be estimated. Consequently, conditional correlations ($\rho_{i,j,t}$) are calculated from the following equation,

$$\rho_{i,j,t} = \frac{q_{i,j,t}}{\sqrt{q_{i,i,t}} \cdot \sqrt{q_{j,j,t}}}. \quad (7)$$

These dynamic conditional correlations ($\rho_{i,j,t}$) are then used as alternative measurements to determine the co-movement between business cycles and provide information on how conditional correlations are changing over time.

DATA

This study covers eight stock markets in East Asia (or ASEAN5+3) — Japan, South Korea, Singapore, Thailand, Malaysia, the Philippines, Indonesia, and China. Moreover, the United States is included in order to represent the major world economy. The stock returns series are calculated from weekly market index during January 1991 to December 2011. All data is collected from Datastream and the stock returns series are plotted in Figure 1.

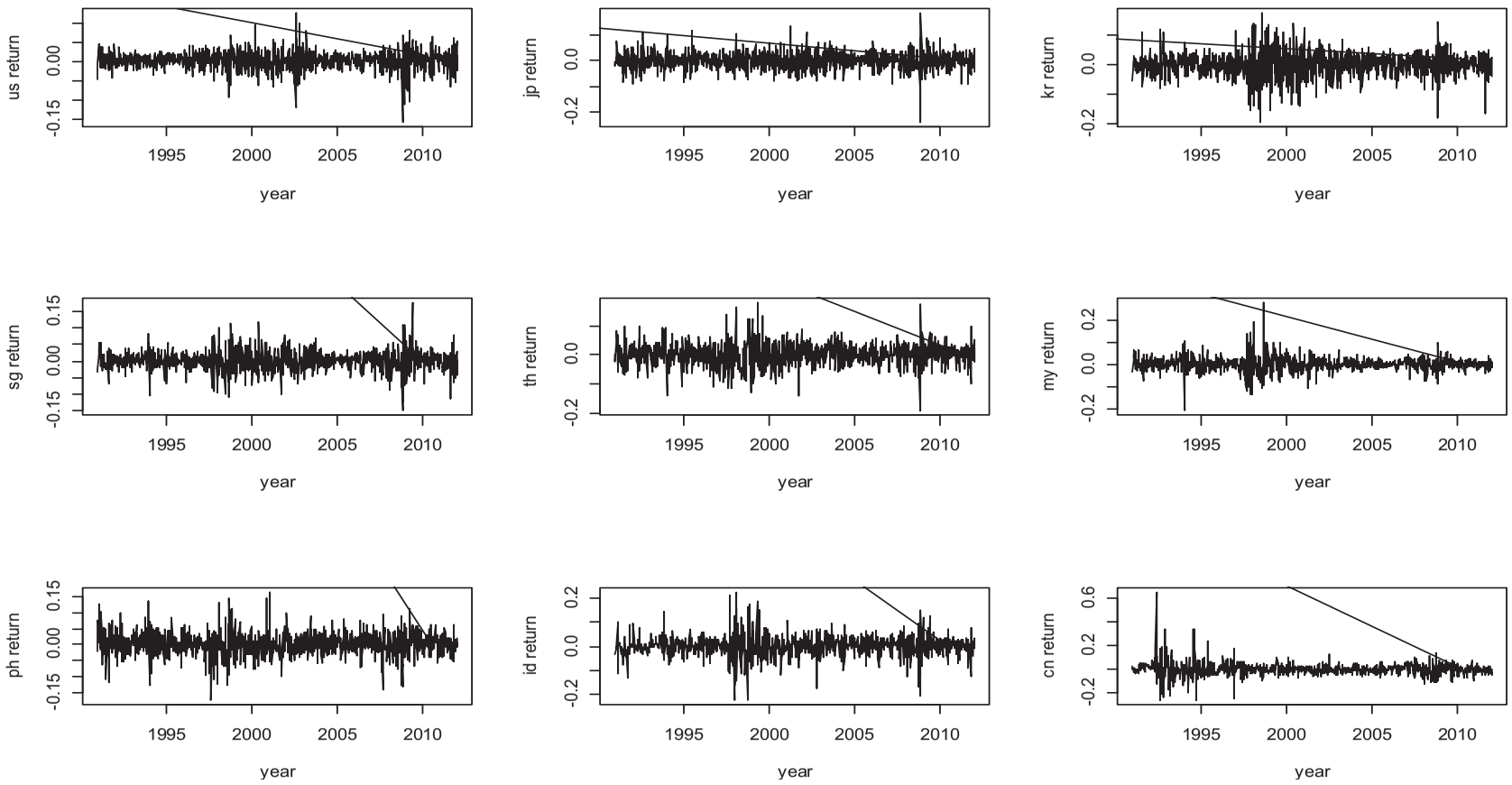


Figure 1 Country Stock Returns

Note: Weekly data; January 1991 – December 2011.
us = United States, jp = Japan, kr = Korea, sg = Singapore, th = Thailand, my = Malaysia, ph = Philippines, id = Indonesia, and cn = China.

Descriptive Statistics

Table 1 presents the statistical properties of the weekly stock returns from eight East Asia countries and the United States. As can be seen, over the sample period, China has the highest weekly stock returns at 0.3 percent while Japan has the negative weekly stock returns at -0.1 percent. Among others, China stock market is the most volatile with standard deviation of 5.5 percent followed by Indonesia and South Korea. The stock returns distribution over time is negatively skewed for all markets except China's. In addition, the stock returns are characterized by a statistically significant kurtosis suggesting that the stock returns have a fatter tail and a higher peak compared with a normal distribution.

Table 1 Descriptive Statistics, Unit Root Test, and Heteroscedasticity Test of the Stock Returns

	Min	Max	Mean	S.D.	Skewness	Excess Kurtosis	ADF-test	$Q^2(k)$
United States	-0.158	0.124	0.001	0.024	-0.569	4.459	-36.555 (0.000)	120.53 (0.000)
Japan	-0.235	0.180	-0.001	0.034	-0.428	4.761	-35.130 (0.000)	360.19 (0.000)
Korea	-0.192	0.173	0.001	0.042	-0.250	2.264	-33.995 (0.000)	165.89 (0.000)
Singapore	-0.150	0.176	0.001	0.030	-0.085	3.178	-32.013 (0.000)	150.56 (0.000)
Thailand	-0.192	0.178	0.000	0.039	-0.031	2.204	-16.125 (0.000)	114.22 (0.000)
Malaysia	-0.209	0.280	0.001	0.032	0.374	9.915	-17.378 (0.000)	157.11 (0.000)
Philippines	-0.171	0.163	0.002	0.036	-0.044	2.310	-31.458 (0.000)	70.508 (0.000)
Indonesia	-0.222	0.226	0.002	0.042	-0.132	5.063	-36.171 (0.000)	227.86 (0.000)
China	-0.259	0.660	0.003	0.055	1.978	24.749	-29.942 (0.000)	47.115 (0.000)

Note: Numbers of lag (k) = 4 for weekly stock returns. The figure in parenthesis represents the *p*-value.

The unit root property is checked by Augmented Dicker Fuller (ADF test). The results show the stock returns series do not contain unit root process. In other words, all series are stationary process. In addition, the Ljung-Box Q statistics of squares residual reveal that there is volatility clustering in every stock returns data. Unlike the stock returns, the conditional heteroscedasticity is found in the United States, Japan, Singapore, Thailand, and China.

Unconditional (Static) Cross-Country Correlations

In this section, the unconditional correlation coefficients are calculated for each pair of countries in our dataset. These statistics provide a basic indicator for financial interdependence. We first compute cross-country correlations using the whole dataset. Next, the whole sample is seperated into 3 sub-sample periods. The first period, 1991 to 1996 is referred to the Asian growth period while the second period, 1997 – 2005, dates the Asian financial crisis. Lastly, the recovering and increasing integration period starts from 2006 onwards.

The unconditional cross-country correlations are then measured in each sub-sample period and they are presented in Tables 2. As can be seen in Tables 2, the unconditional cross-country correlations are not stable over sample period and they are more integrated with each other during the last decade. However, the dynamic nature of cross-country correlation should be considered besides the static one. Therefore, the next section will present the dynamic interdependence in the East Asian which estimated from DCC-GARCH as well as the results of trend regression analysis.

Table 2 Cross-Country Correlations of Stock Returns (Weekly data)

Time Periods	US	JP	KR	SG	TH	MY	PH	ID	CN
	Correlations with United States								
1991 – 1996	**1.000**	0.181	0.065	0.287	0.192	0.287	0.243	0.000	0.012
1997 – 2005	**1.000**	0.328	0.302	0.423	0.292	0.289	0.259	0.111	-0.014
2006 – 2011	**1.000**	0.365	0.561	0.717	0.603	0.567	0.431	0.401	0.263
whole period	**1.000**	0.313	0.334	0.512	0.363	0.336	0.304	0.183	0.066
	Correlations with Japan								
1991 – 1996		**1.000**	0.226	0.220	0.079	0.094	0.053	0.102	0.016
1997 – 2005		**1.000**	0.345	0.242	0.240	0.214	0.128	0.258	0.071
2006 – 2011		**1.000**	0.601	0.383	0.448	0.455	0.275	0.646	0.256
whole period		**1.000**	0.380	0.287	0.260	0.227	0.152	0.341	0.086
	Correlations with Korea								
1991 – 1996			**1.000**	0.189	0.096	0.145	0.007	0.112	-0.053
1997 – 2005			**1.000**	0.331	0.411	0.244	0.234	0.291	-0.028
2006 – 2011			**1.000**	0.616	0.599	0.609	0.384	0.631	0.285
whole period			**1.000**	0.380	0.389	0.280	0.214	0.340	0.025
	Correlations with Singapore								
1991 – 1996				**1.000**	0.531	0.751	0.358	0.113	-0.011
1997 – 2005				**1.000**	0.464	0.473	0.378	0.337	0.058
2006 – 2011				**1.000**	0.682	0.699	0.586	0.473	0.372
whole period				**1.000**	0.534	0.554	0.430	0.342	0.102
	Correlations with Thailand								
1991 – 1996					**1.000**	0.514	0.281	0.199	0.022
1997 – 2005					**1.000**	0.407	0.418	0.357	0.051
2006 – 2011					**1.000**	0.620	0.517	0.550	0.273
whole period					**1.000**	0.464	0.406	0.373	0.077

Table 2 Cross-Country Correlations of Stock Returns (Weekly data) (cont')

Time Periods	US	JP	KR	SG	TH	MY	PH	ID	CN
	Correlations with Malaysia								
1991 – 1996						**1.000**	0.317	0.078	-0.027
1997 – 2005						**1.000**	0.325	0.368	0.049
2006 – 2011						**1.000**	0.562	0.623	0.411
whole period						**1.000**	0.361	0.355	0.064
	Correlations with Philippines								
1991 – 1996							**1.000**	0.094	0.012
1997 – 2005							**1.000**	0.249	0.007
2006 – 2011							**1.000**	0.404	0.336
whole period							**1.000**	0.252	0.079
	Correlations with Indonesia								
1991 – 1996								**1.000**	0.081
1997 – 2005								**1.000**	0.085
2006 – 2011								**1.000**	0.298
whole period								**1.000**	0.110

Notes: The first time period; 1991 – 1996 refers to Asian growth period, the period 1997 – 2005 represents the Asian economic crisis, and the period after 2006 refers to the increasing integration period. Each figure represents the average correlation of weekly stock returns in each sub-period.

EMPIRICAL RESULTS

The DCC-GARCH(1,1) models are estimated using the output growths and stock returns in eight East Asian countries and the United States. The estimation results are shown in Table 3.
The first row reports the mean estimation while the next three rows provide the estimated coefficients of univariate GARCH(1,1) for each of variance equation. The last two rows show the estimation of the DCC(1,1) parameters. Overall, the results show that most of the estimated parametersof the DCC-GARCH models are statistically significant. The conditional cross-countries correlations of stock returns are generated through DCC-GARCH model and they are plotted in Appendix. Obviously, the diagrams reveal that there are significant variations in the cross-country correlation pattern and also significant peaks in some period.

As can be seen in Table 4 and Appendix, the results show the cross-correlation series are unstable and fluctuated over time. In most case, the highest cross-country correlations are found during the period of the Global Financial Crisis in 2007 - 2008. The stock returns in Thailand, Malaysia and Singapore seem to have highest correlation with other countries in the regions. The lowest degree of cross-country correlations is observed in case of China and Indonesia. Considering the change in this correlation though time, we observed that the level in conditional cross-country correlations is increasing, especially after 2005.

Table 3 DCC-GARCH (1,1) Estimations

Coefficients	United States	Japan	Korea	Singapore	Thailand	Malaysia	Philippines	Indonesia	China
	DCC-GARCH (1,1) Estimations of Stock Returns								
μ	0.002 (0.001)	0.000 (0.001)	0.002 (0.001)	0.001 (0.001)	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)	0.004 (0.001)	0.001 (0.001)
ω	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
α	0.118 (0.029)	0.132 (0.054)	0.095 (0.027)	0.124 (0.046)	0.100 (0.043)	0.137 (0.049)	0.114 (0.036)	0.208 (0.142)	0.206 (0.073)
β	0.873 (0.029)	0.696 (0.137)	0.885 (0.031)	0.859 (0.053)	0.869 (0.058)	0.857 (0.052)	0.830 (0.053)	0.709 (0.197)	0.788 (0.064)
a	0.011 (0.002)								
b	0.978 (0.004)								

Note: The standard error of estimated coefficient is in parenthesis

Finally, we address the question that whether the cross-country (conditional) have tendency to increase over time or temporary rise during particular period. The trend regression is then estimated. Specifically, the conditional cross-country correlations ($\hat{\rho}_{i,j,t}$) are used as dependent variable and time trend ($Trend_t$) is used as explanatory variable. Equation (8) represents the trend regression and the estimation results are reported in Table 5.

$$\hat{\rho}_{i,j,t} = \gamma_{i,0} + \gamma_{i,1} Trend_t + v_t, \tag{8}$$

Table 4 Cross-Country Conditional Correlations of Stock Returns

	US	JP	KR	SG	TH	MY	PH	ID	CN
US	**1.000**	0.334	0.320	0.470	0.339	0.383	0.298	0.168	0.082
JP		**1.000**	0.382	0.298	0.241	0.247	0.158	0.302	0.082
KR			**1.000**	0.366	0.344	0.279	0.210	0.313	0.044
SG				**1.000**	0.498	0.578	0.406	0.293	0.117
TH					**1.000**	0.453	0.383	0.311	0.083
MY						**1.000**	0.354	0.314	0.134
PH							**1.000**	0.245	0.079
ID								**1.000**	0.126
CN									**1.000**

Note: The conditional correlations are calculated from DCC-GARCH(1,1) model. Each figure represents the average weekly conditional correlations of stock returns over the whole sample periods, January 1991 – December 2011.

Obviously, Table 5 shows that all of the estimated coefficients in trend regression (except the Malaysia – Singapore pair) are positively significant which indicate that the cross-country correlations of stock returns in ASEAN5+3 and the United States are increasing over time.

Table 5 Trend Regressions for Conditional Correlation of Stock Returns

Cross Correlation	Intercept	Slope	p-value
us – jp	0.268	1.21×10^{-4}	0.000
us – kr	0.172	2.70×10^{-4}	0.000
us – sg	0.348	2.24×10^{-4}	0.000
us – th	0.227	2.04×10^{-4}	0.000
us – my	0.303	1.47×10^{-4}	0.000
us – ph	0.242	1.04×10^{-4}	0.000
us – id	0.065	1.88×10^{-4}	0.000
us – cn	0.002	1.46×10^{-4}	0.000
jp – kr	0.259	2.25×10^{-4}	0.000
jp – sg	0.251	8.56×10^{-5}	0.000
jp – th	0.160	1.47×10^{-4}	0.000
jp – my	0.179	1.25×10^{-4}	0.000
jp – ph	0.111	8.61×10^{-5}	0.000
jp – id	0.176	2.29×10^{-4}	0.000
jp – cn	0.019	1.15×10^{-4}	0.000
kr – sg	0.244	2.24×10^{-4}	0.000
kr – th	0.227	2.14×10^{-4}	0.000
kr – my	0.152	2.33×10^{-4}	0.000
kr – ph	0.105	1.92×10^{-4}	0.000
kr – id	0.183	2.38×10^{-4}	0.000
kr – cn	-0.041	1.55×10^{-4}	0.000
sg – th	0.465	6.14×10^{-5}	0.000
sg – my	0.588	-1.82×10^{-5}	0.028
sg – ph	0.336	1.27×10^{-4}	0.000
sg – id	0.225	1.24×10^{-4}	0.000
sg – cn	0.005	2.05×10^{-4}	0.000
th – my	0.431	4.15×10^{-5}	0.000
th – ph	0.327	1.03×10^{-4}	0.000
th – id	0.247	1.17×10^{-4}	0.000
th – cn	-0.005	1.63×10^{-4}	0.000
my – ph	0.285	1.27×10^{-4}	0.000
my – id	0.195	2.18×10^{-4}	0.000
my – cn	0.011	2.25×10^{-4}	0.000
ph – id	0.184	1.11×10^{-4}	0.000
ph – cn	-0.010	1.63×10^{-4}	0.000
id – cn	0.066	1.09×10^{-4}	0.000

CONCLUSION AND POLICY IMPLICATION

This paper examines the dynamic pattern of co-movement among the stock markets in the East Asian economies. The Dynamic Conditional Correlation (DCC) – GARCH model is used to generate conditional cross-country correlations. Beside from the results that the cross-country correlations of stock return are time-varying, the trend regression analysis shows that the cross-country conditional correlations are increasing over time in every case.

Overall, we conclude the following policy implications from this study:-

i) Financial linkage within the East Asian region and with the global financial market is more linked and is continuously increasing. Therefore, regulators and prospect investors should pay attention in volatility transmission between markets rather than focus only domestic risk.

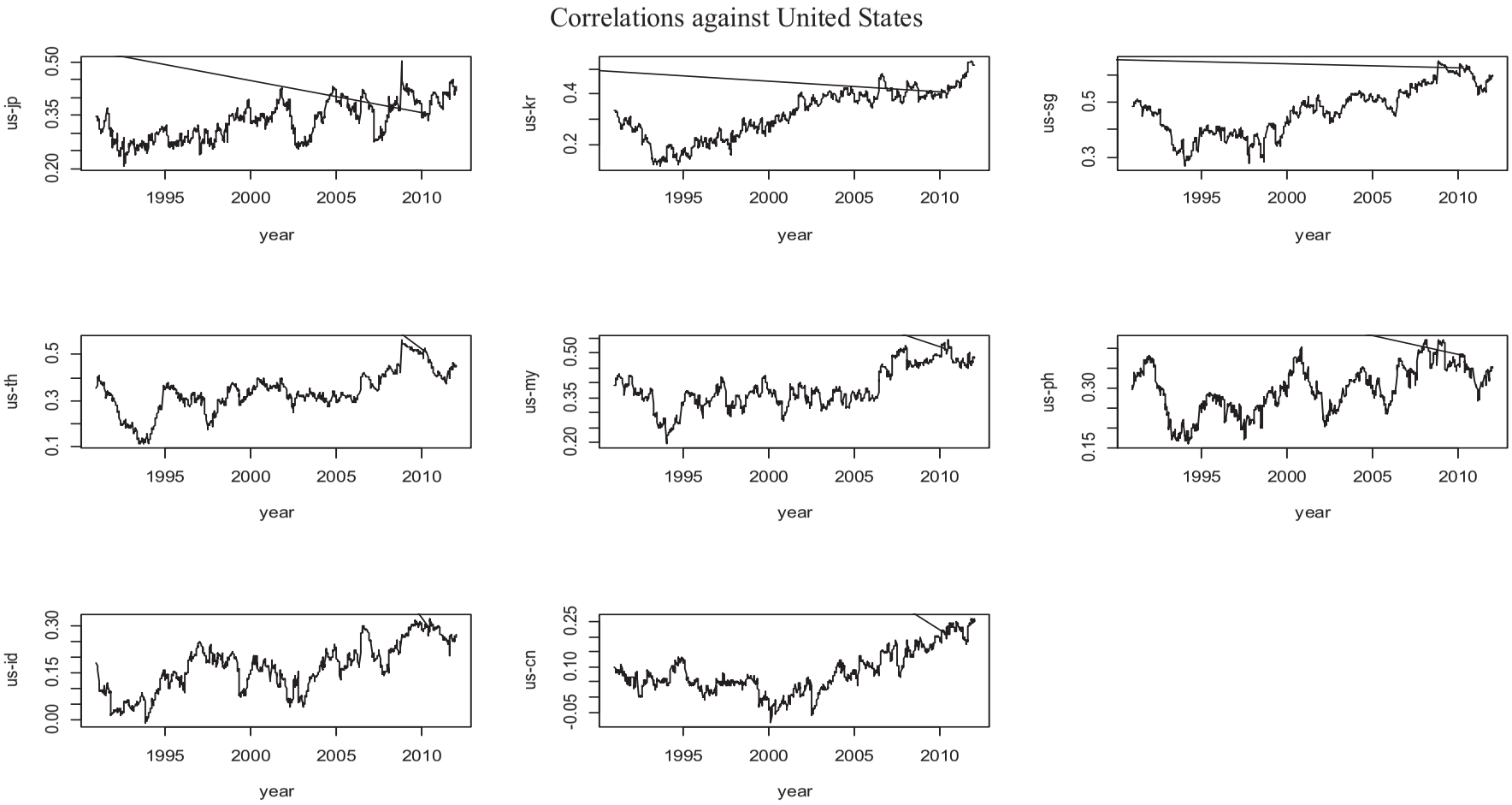
ii) The time-varying correlations usually rise significantly during the economic crisis when risk diversification is needed most. Hence, the East Asian countries should emphasize in preparing the cooperation mechanism, i.e. establishing emergency fund and/or setting up policy coordination with the aim to support or provide regional stability during economic crisis.

iii) The gain from international diversification within and outside the East Asian region decreases over time. Therefore, the domestic factors will be more important to attract capital flow in the region than the diversification gain.

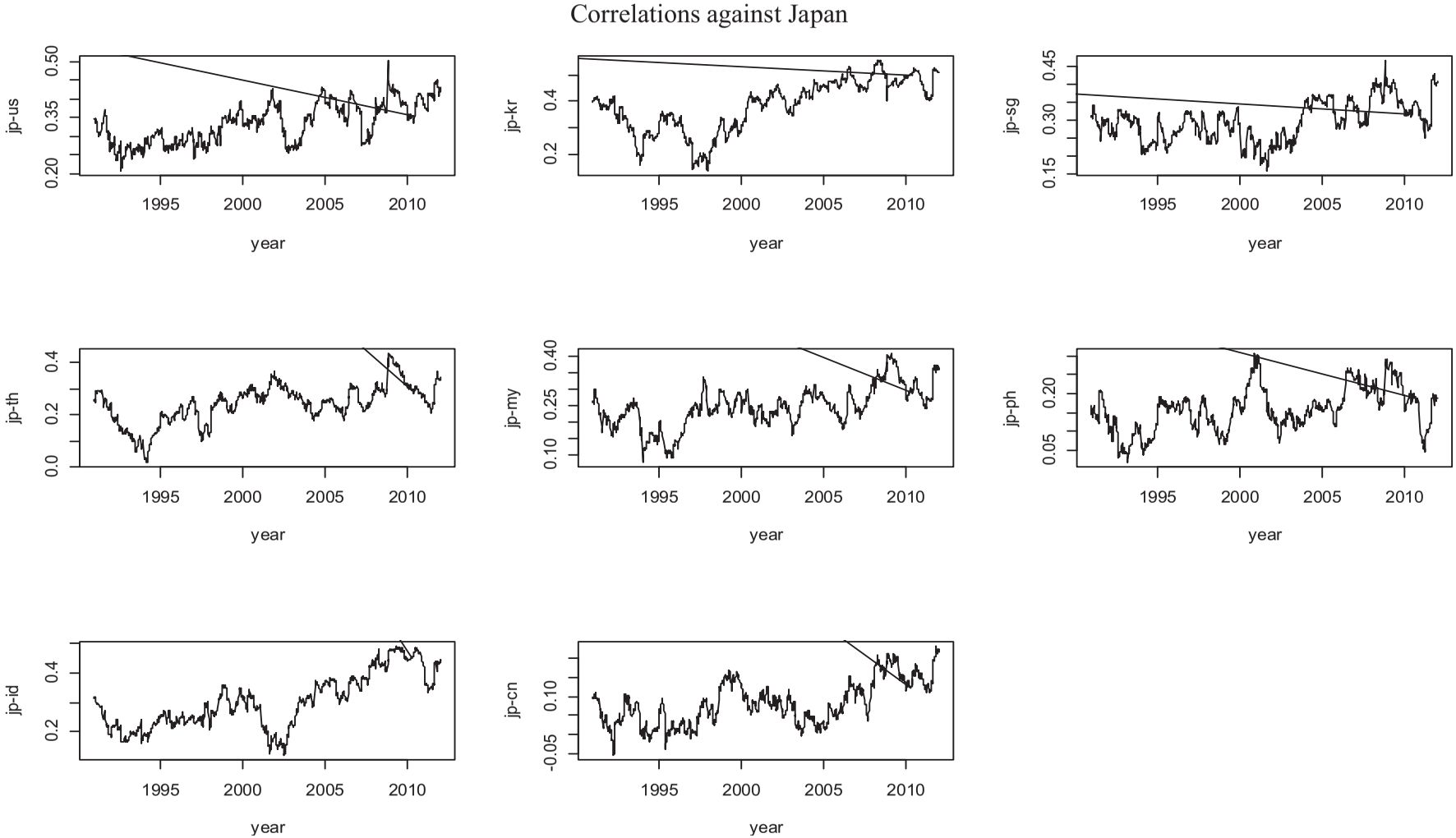
REFERENCES

1. Ang, A. & Bekaert, G. (2002) International Asset Allocation with Regime Shifts. *Review of Financial Studies*. 15 (4). 1137-1187.
2. Engle, R. (2002) Dynamic Conditional Correlation: A Simple Class of Multivariate Generalized Autoregressive Conditional Heteroskedasticity Models. *Journal of Business & Economic Statistics*. 20 (3). 339-350.
3. Engle, R. & Colacito (2006) Testing and Valuing Dynamic Correlations for Asset Allocation. *Journal of Business & Economic Statistics*. 24 (2). 238-253.
4. Erb, C.B., Campbell, R.H. & Viskanta, T.E. (1994) Forecasting International Equity Correlations. *Financial Analysts Journal*. 50. 32-45.
5. Gupta, R. & Donleavy, G.D. (2009) Benefits of Diversifying Investment into Emerging Markets with Time-Varying Correlations: An Australian Perspective. *Journal of Multinational Financial Management*. 19. 160-177.
6. Lavey, H. & Sarna, M. (1970) International Diversification of Investment Portfolios. *American Economic Review*. 60(4). 668-675.
7. Longin, F. & Solnik, B. (1995) Is the Correlation in International Equity Return Constant: 1960-1990? *Journal of International Money and Finance*. 14. 3-26.
8. Solnik, B. (1974) Why Not Diversify Internationally? *Financial Analysts Journal*. 30. 48-54.
9. Wang, P. & Moore, T. (2008) Stock Market Integration for the Transition Economies: Time-varying Conditional Correlation Approach. *The Manchester School*. 116-133.
10. Yang, S-Y. (2005) A DCC Analysis of International Stock Market Correlations: The Role of Japan on the Asian Four Tigers. *Applied Financial Economics Letters*. 1. 89-93.
11. You, L. & Daigler, R.T. (2010) Is International Diversification Really Beneficial? *Journal of Banking and Finance*. 34. 163-173.

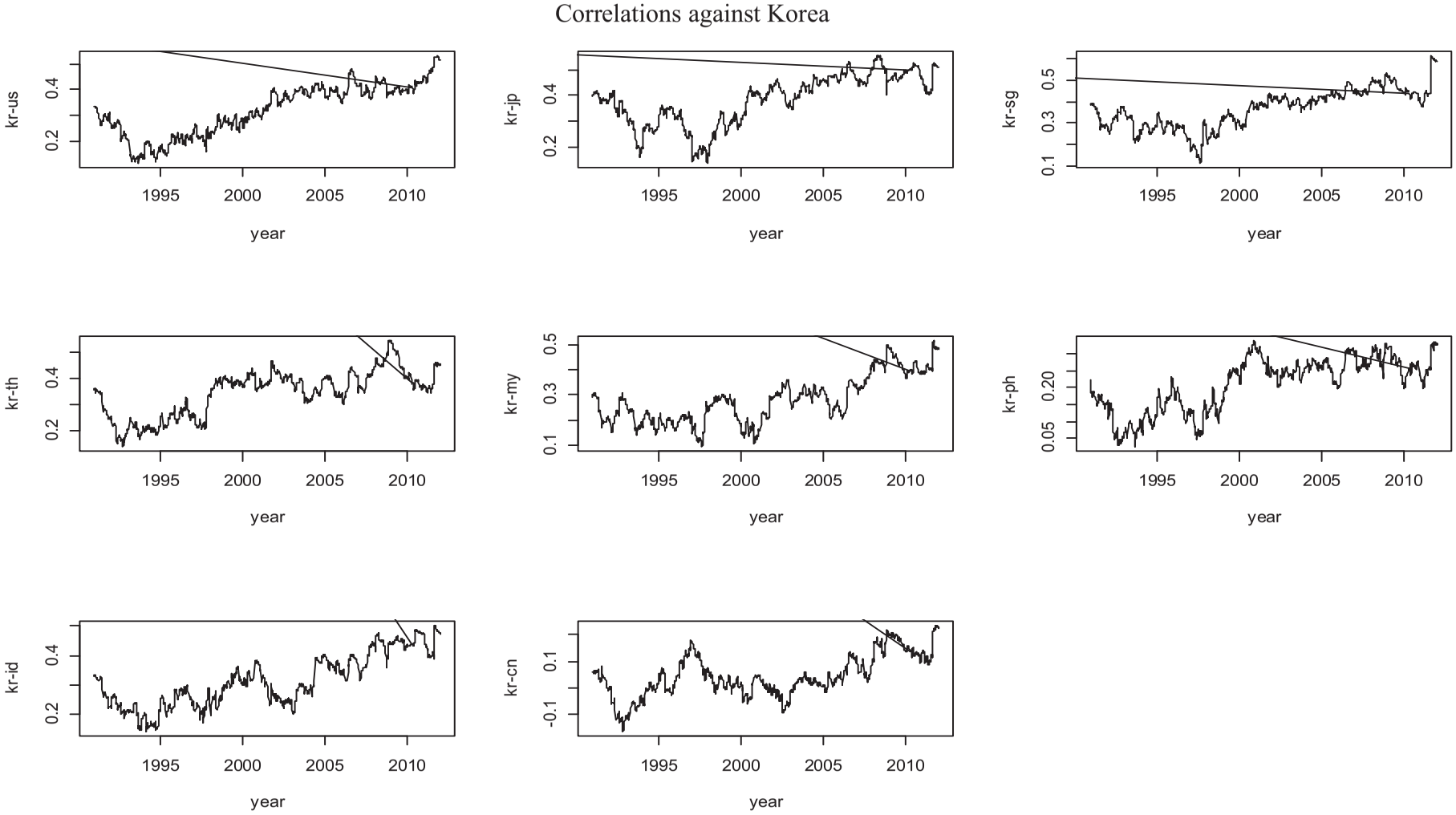
Appendix Cross-Country Conditional Correlations of Stock Returns



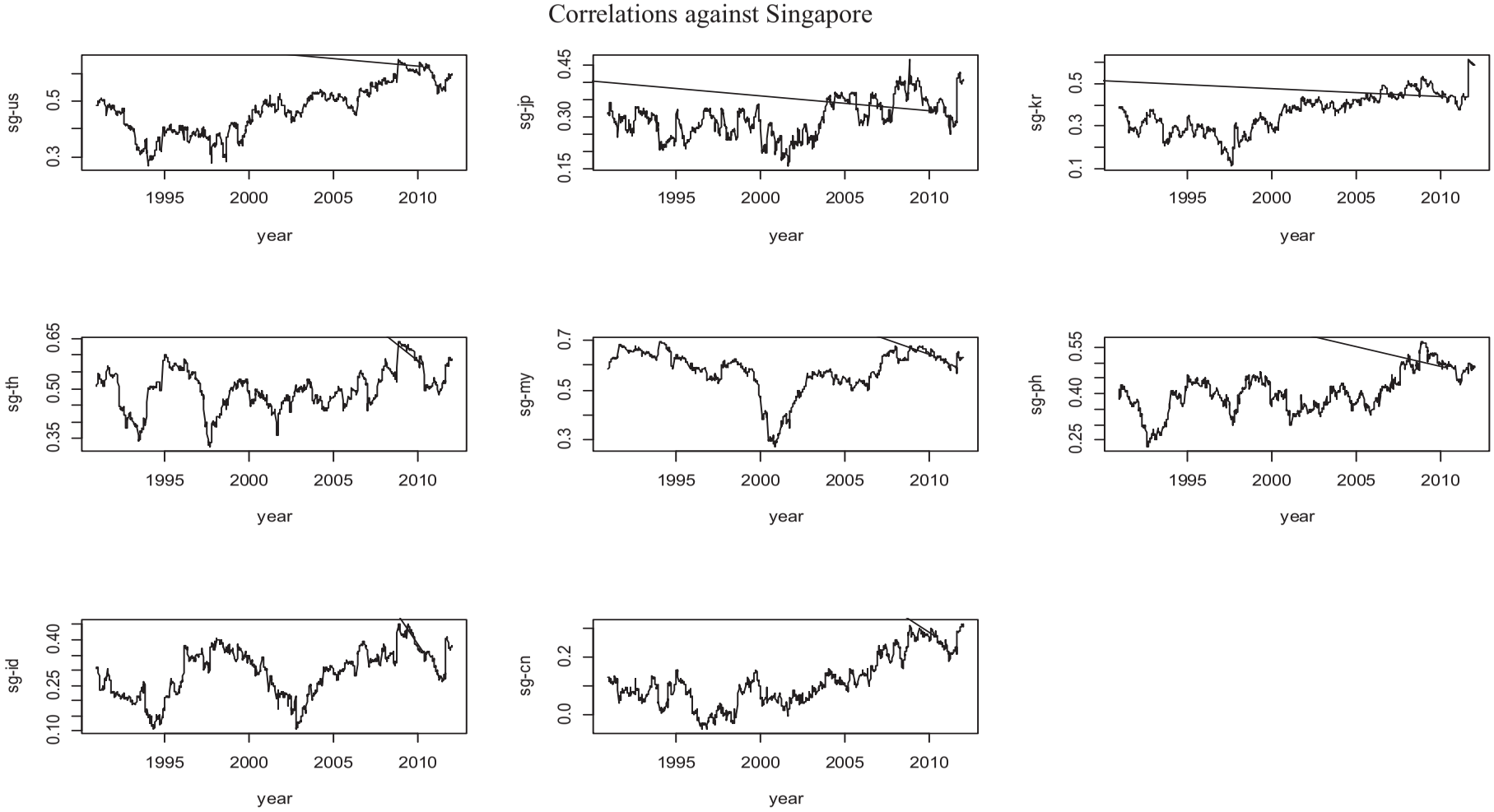
Appendix Cross-Country Conditional Correlations of Stock Returns (cont')



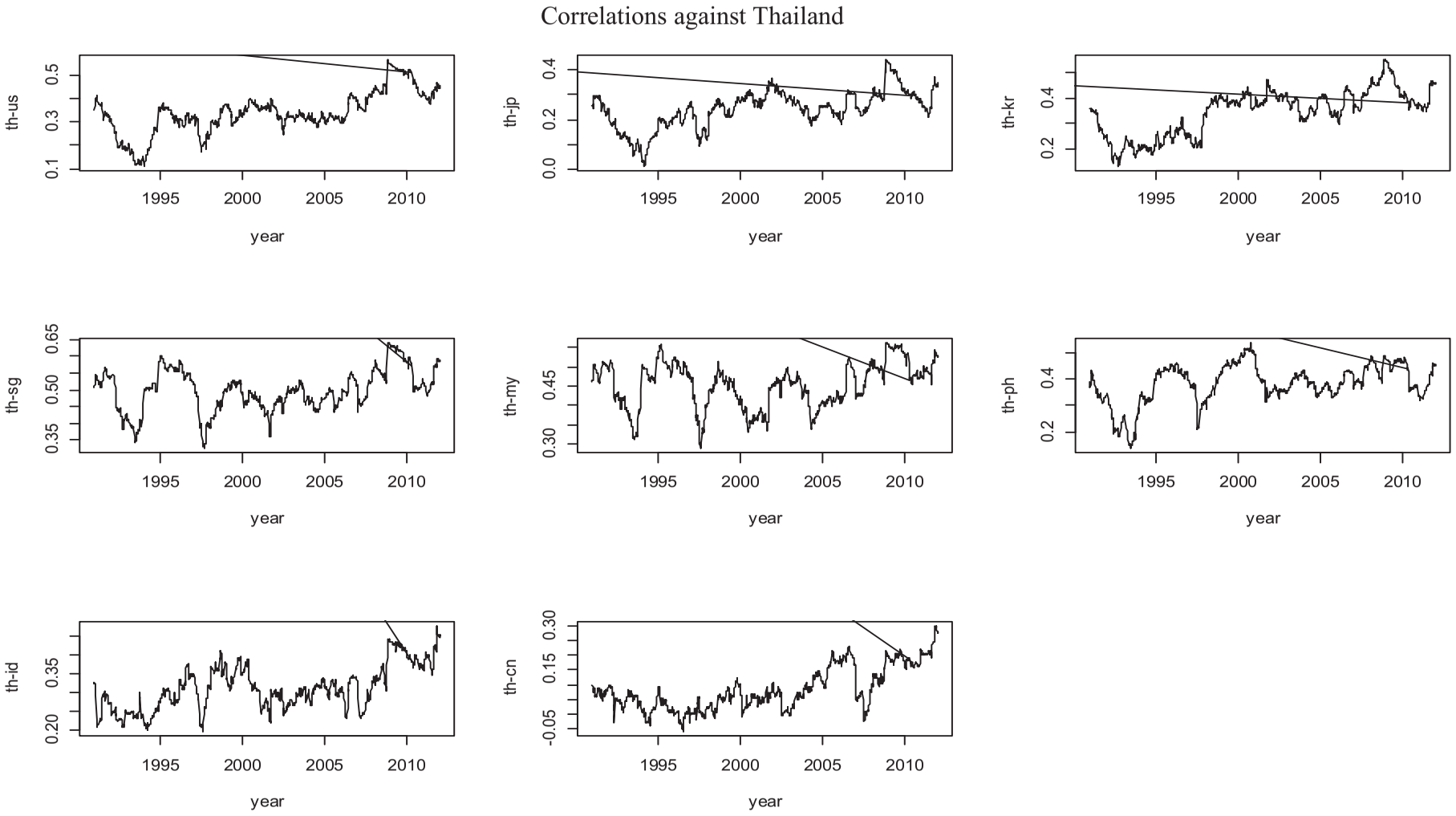
Appendix Cross-Country Conditional Correlations of Stock Returns (cont')



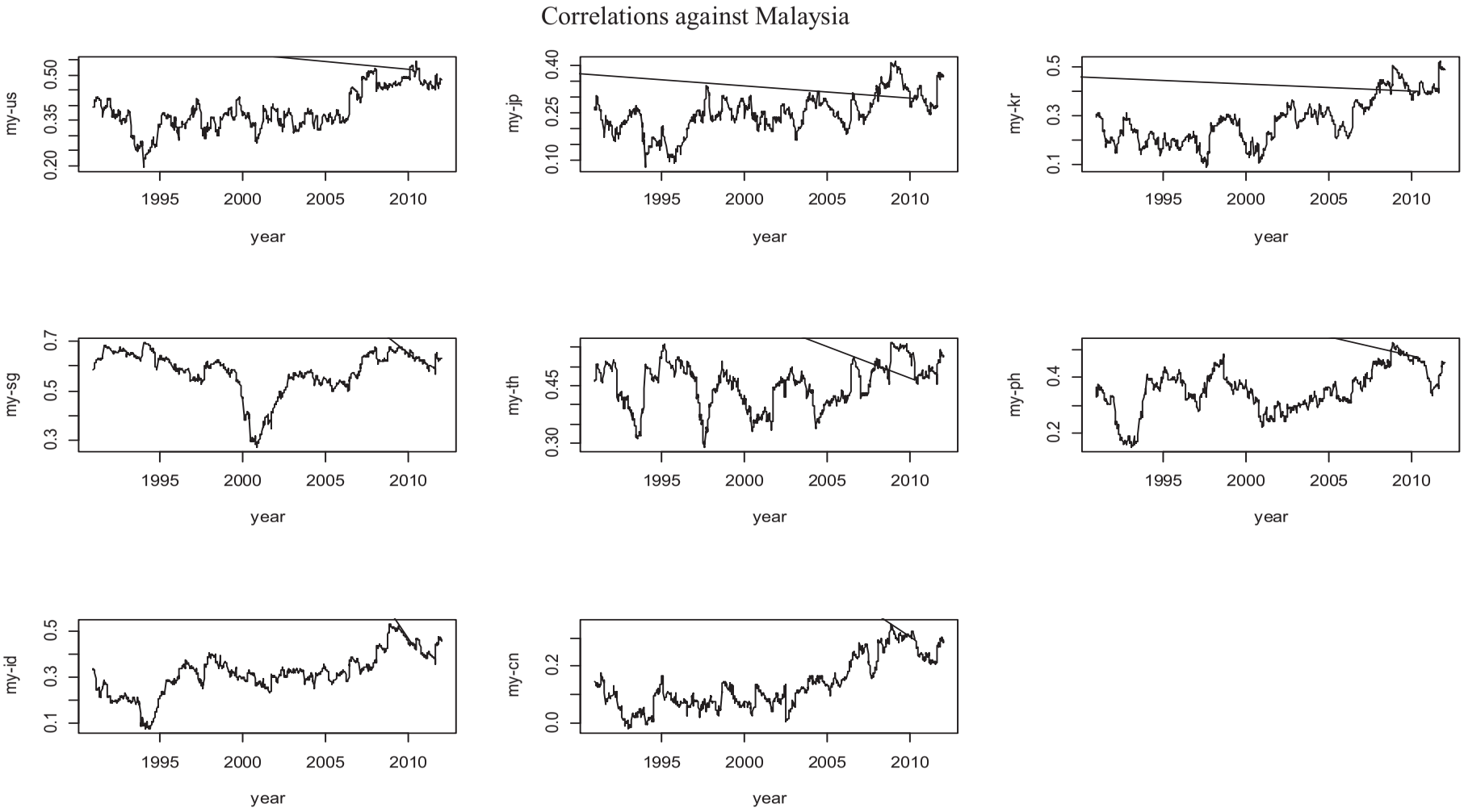
Appendix Cross-Country Conditional Correlations of Stock Returns (cont')



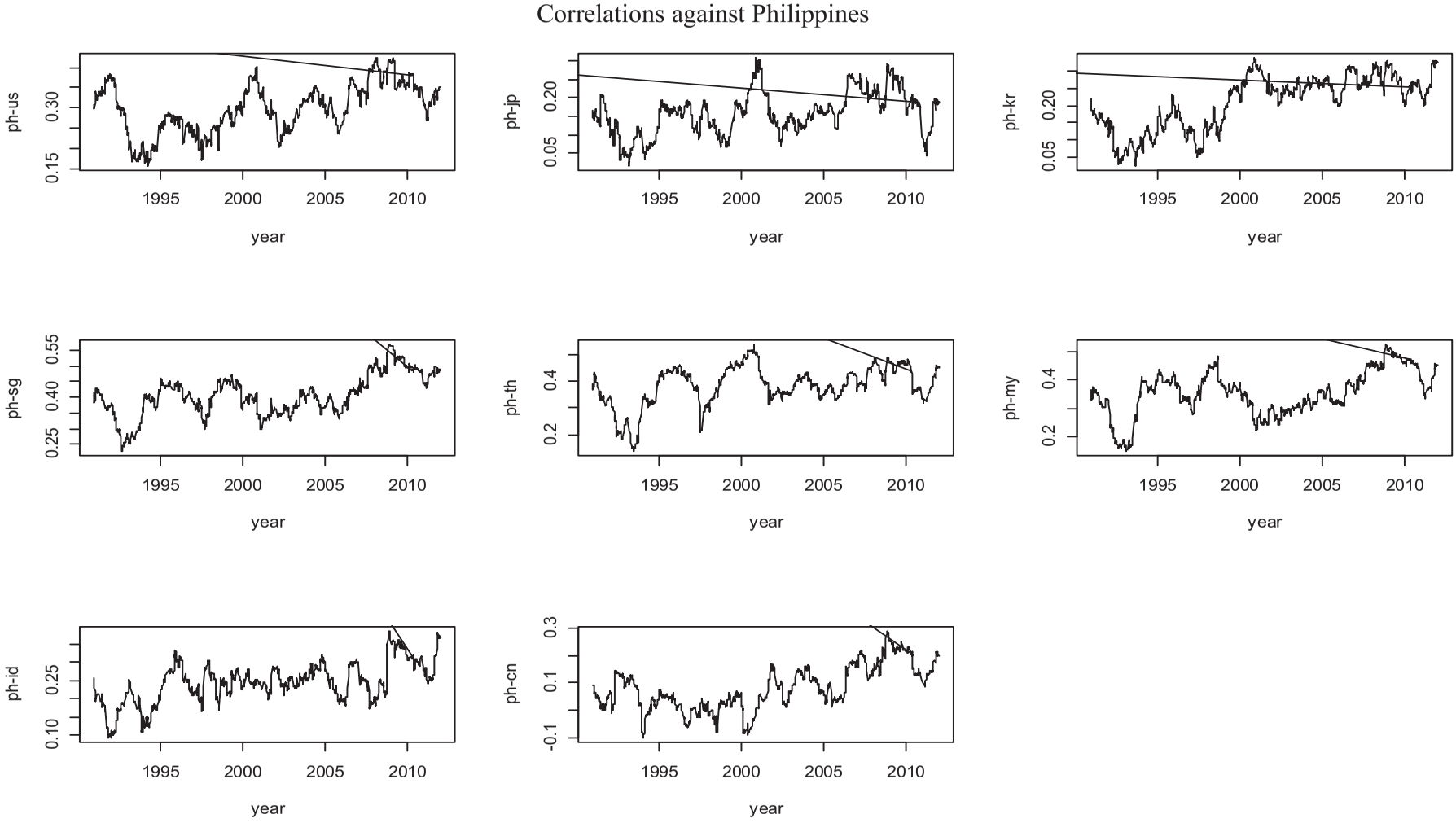
Appendix Cross-Country Conditional Correlations of Stock Returns (cont')



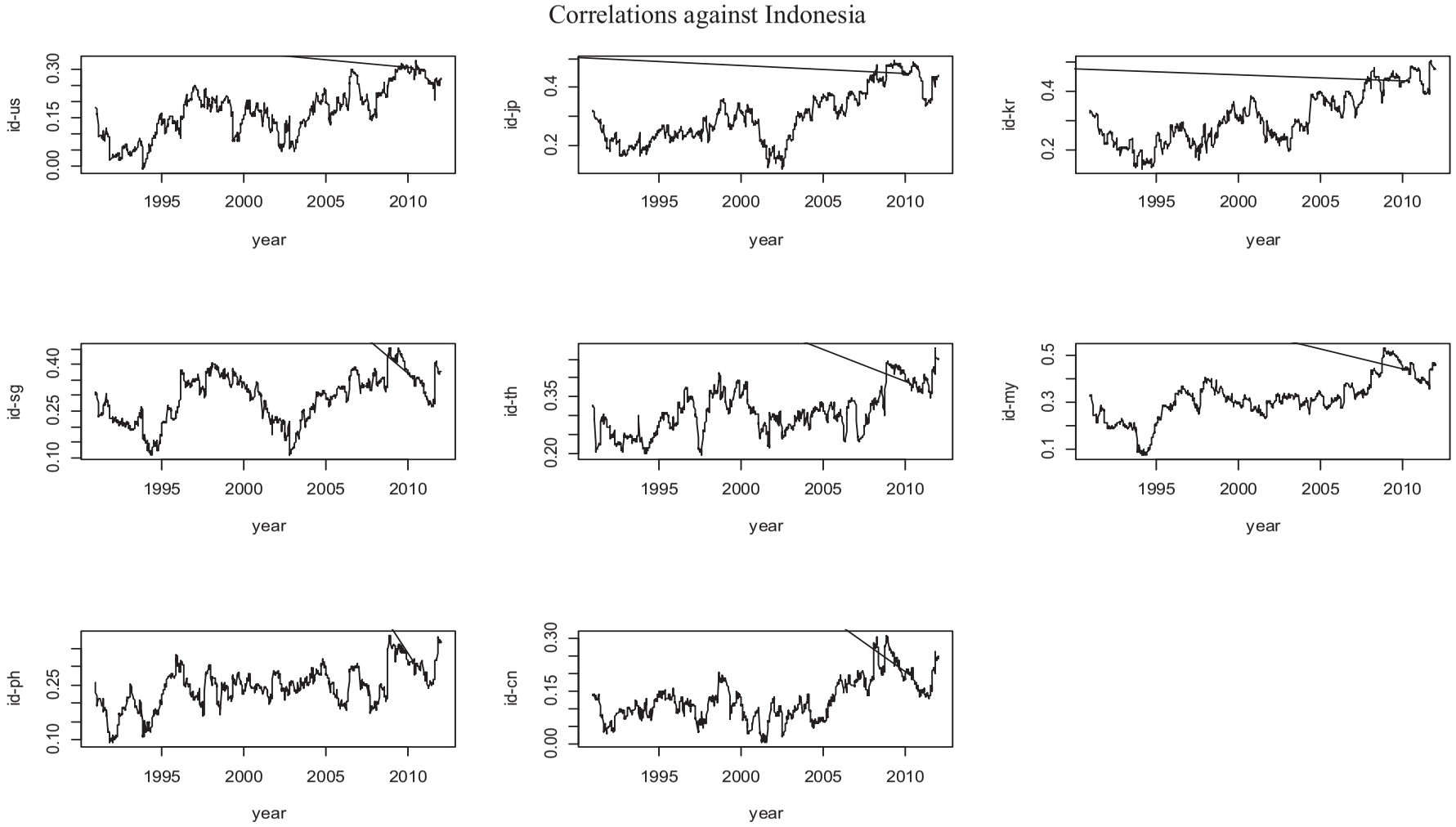
Appendix Cross-Country Conditional Correlations of Stock Returns (cont')



Appendix Cross-Country Conditional Correlations of Stock Returns (cont')

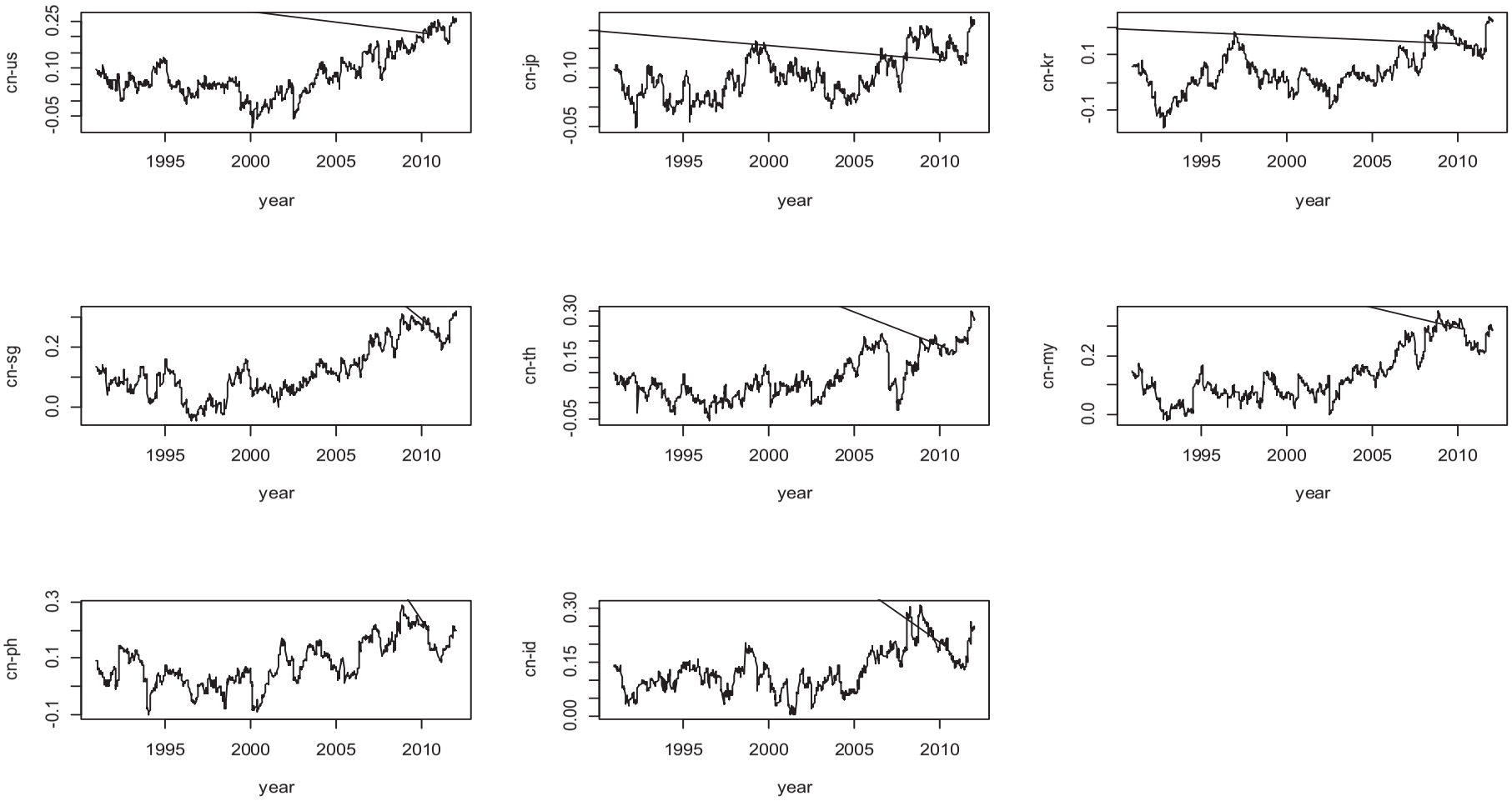


Appendix Cross-Country Conditional Correlations of Stock Returns (cont')



Appendix Cross-Country Conditional Correlations of Stock Returns (cont')

Correlations against China



Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

ORGANIZATIONAL LEARNING: A MEDIATING FACTOR BETWEEN TECHNOLOGICAL INNOVATION AND TQM

[*]Voon-Hsien Lee, Universiti Tunku Abdul Rahman, Malaysia

Keng-Boon Ooi, Linton University College, Malaysia

Chee-Keong Choong, Universiti Tunku Abdul Rahman, Malaysia

Kee-Luen Wong, Universiti Tunku Abdul Rahman, Malaysia

***Corresponding author: Voon-Hsien Lee. Address: Faculty of Business and Finance, Universiti Tunku Abdul Rahman, email: leevoonhsien@gmail.com**

ABSTRACT

Organizations nowadays are faced with many competitive obstacles due to the rapid change in technology. Both practitioners and management theorists have called for innovation to take place in production processes and production lines as well as in management practices. Total quality management, also famously known as TQM, has long been established as a major management practices adopted by organizations word wide. However, recently, organizational learning dimensions have also gained popularity in organizations. Furthermore, technological innovation has also gained considerable attention as vital in securing a sustainable competitive advantage in the business world.

This study investigates the relationship between TQM, organizational learning and technological innovation. A conceptual model was developed with the adoption of the six TQM practices from the Malcolm Baldrige National Quality Award (MBNQA) (i.e. leadership, strategic planning, human resource management, customer focus, process management, and information analysis) to test of its relationship with both organizational learning and technological innovation respectively. Furthermore, the study also proposes that organizational learning acts as a mediating variable between these six TQM practices with technological innovation.

The conceptual framework serves as a basic foundation to investigate the level of influence the six TQM constructs can have on both organizational learning and technological innovation respectively; and whether organizational learning mediates the relationship between TQM and technological innovation. This study proposes that the relationships between these three constructs are positive.

Data will be gathered from the managers working in the Malaysian ISO manufacturing firms, in which this provides the empirical data required. Multiple linear regression will be used to analyze the relationships between TQM and organizational learning; and TQM on technological innovation; while and Baron and Kenny three-step procedures will be used to analyze the role of

organizational learning being a mediating variable between TQM and technological innovation. One of the main limitations of this study is that the paper only focuses on the manufacturing firms, hence limiting the generalization to the manufacturing sector in Malaysia.

Theoretically, the proposed conceptual framework fills the current discrepancy and subsequent gap in knowledge as the present theoretical framework used in this study emphasizes on those TQM dimensions that are predominantly important to ascertain a high level of organizational learning and technological innovation among the local ISO firms in Malaysia. Hence, this study is believed to advance the TQM literature and to provide both quality management practitioners and academicians a deeper comprehension on the association between TQM practices, organizational learning and technological innovation. Furthermore, the establishment of the mediating relationships between the TQM constructs, organizational learning and technological innovation in this study is an essential distinction that previous studies have not identified.

Practically, this study revealed the significance of the TQM practices in which it reemphasizes the general belief that the TQM dimensions are positively and significantly linked with both organizational learning and technological innovation. This article also puts forth some valuable insights to help the managers of the Malaysian manufacturing ISO firms to recognize problem areas in their own firms and to carry out corrective actions. Furthermore, this present research study has also put forth the importance of organizational learning being the mediating factor between TQM practices and technological innovation. In other words, it is strongly believed that one effective way to stimulate technological innovation within a firm is to enhance the organizational learning behaviour among the employees through the effective implementation of the various TQM practices.

Keywords: Total quality management, organizational learning, technological innovation, Malaysia.

BIOGRAPHY

Voon-Hsien Lee is a Lecturer at the Faculty of Business and Finance, Universiti Tunku Abdul Rahman, Malaysia. She received both her Bachelor's and Master's degrees in Accounting from Monash University. She is currently pursuing her PhD in the area of Total Quality Management (TQM) at Universiti Tunku Abdul Rahman, Malaysia. Her current research interests include TQM, human resource management, and organizational learning.

Keng-Boon Ooi is a Professor and Deputy Vice Chancellor for Research and Quality Assurance, Linton University College, Malaysia. He is also a Singapore Internet Research Centre Associate with the Wee Kim Wee School of Communication and Information, Nanyang Technology University, Singapore. He has published over 70 articles in refereed journals.

Chee-Keong Choong is a Professor in the Faculty of Business and Finance, Universiti Tunku Abdul Rahman (UTAR), Malaysia. He received his PhD (Financial Economics) Degree from Universiti Putra Malaysia, Malaysia. Apart from teaching, he is actively involved in research in the areas of applied macroeconomics, managerial and financial economics.

Kee-Luen Wong is an Assistant Professor for the Faculty of Business and Finance, Universiti Tunku Abdul Rahman (UTAR), Malaysia. He was formerly the Head of Department (HoD) of the Department of Business before he stepped down to focus on research and publications. He received his Doctor of Education (EdD) degree from the University of Leicester, United Kingdom in 2009. His other academic qualifications are Advanced Diploma in Business Management (ADipBM), Postgraduate Diploma in Business Administration (PGDipBA) and Master of Business Administration (MBA), all from the University of Wales, United Kingdom. In 2012, he was awarded the Advanced Diploma in Management Accounting by the Chartered Institute of Management Accountants (CIMA).

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

DETERMINANTS ELECTRICITY DEMAND IN INDUSTRY AND HOUSEHOLDS

Štefan Bojnec, University of Primorska, Slovenia
Email: stefan.bojnec@fm-kp.si

Drago Papler, University of Primorska, Slovenia
Email: drago.papler@gmail.com

ABSTRACT

Purpose: *This paper investigates determinants of electricity demands by industrial enterprises and households during deregulation and liberalisation of electricity distribution markets with changing competition among electricity distribution enterprises.*
Methodology: *Demand function is employed using ordinary least square regression analysis on time-series data.*
Findings: *The electricity demand in industry is positively associated with real gross domestic product, real substitute prices for natural gas and real prices of fuel oil, but negatively with real price of electrical energy and with the dummy variable for electricity market liberalization. The electricity demand by households is positively associated with households' real income, real substitute prices for natural gas and for fuel oil, and with the dummy variable for market liberalization, but negatively with real price of electrical energy for higher tariff rate for households.*
Originality: *The electricity demand is explained by real price of electrical energy, real income, real prices of substitutes of electrical energy in consumption, and a dummy variable for electricity market liberalization and the Gini coefficient of market concentration. The electricity demand functions are estimated for industry and for households, respectively. The effect of market liberalization on electricity demand differs between industry and households because the electricity market liberalization for industry has also been in place for a longer period than for households.*

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

DEVELOPING CREDIT RATING INDICATORS OF CUSTOMERS FOR ELECTRONIC COMPANIES

Dr. Hsiao-Chen Chang*, Assistant Professor, Department of Leisure Business Management, Chungyu Institute of Technology

Dr. Kuang-Hsun Shih, Professor & Principal, Department of Financial & Economic Law, Toko University

Ming-Fang Lee, Doctoral Student, International Business Management, Chinese Culture University

Yi-Hsuan Chou, Graduate, International Business Management, Chinese Culture University

ABSTRACT

In the past, the electronic business made the research on its customers' credit situation through the financial institutions so as to decrease the risk of bad debt and the cost. However, even seemingly normal, the situation of bill and check exchange does not necessarily mean that the company's credit condition is really plausible. This research, on the bases of literature review and the factors used by the credit institutions to examine the customers, constructs the index for the electronic business to review its customers, taking the content of this enterprise's examination of its internal customers as an important reference. Analytic Network Process Method (ANP) is used to find the factors and dimensions for this index. The result of this research includes that "the characteristics of the industry" does not possess influence, while the "financial aspects" are apparently more influential than the "scale of the business." Among these factors, the "cash flow, profitability, and assets turnover ratio" are the key points. This research suggests that the construction of the index for examining credit situation still has to include the scale of business, because the structure of the enterprise is also central to the examination.

Keywords: Credit Index, Credit Rating Indicators, Analytic Network Process Method (ANP)

INTRODUCTION

The continuation of 2011 debt disaster in Europe causes the setbacks of the economics of European countries. The financial markets confront great challenges. Duff and Eining (2009), on the basis of 2007 financial tsunami, finds in his research that the situations of the management, of the global evaluation, and of the national control have influences on the credit evaluation results. The second disaster, according to the researcher, will result in enormous loss to the global industries. Conscious of this threat, the domestic financial organizations seek the defense mechanism and the solution, hoping to decrease the risks. The industries in our nation have small domestic marker, relying on exportation to expand this

market. Therefore, international economics take the significant position in our economical environment. When the financial disasters take place, the decline of the global economics encloses the management system of some enterprises with weak financial structure. In order to prevent the influence of the enclosed clients, establishing the evaluation system of credits stands as an important topic.

The electronic industries in Taiwan for now stand as the major exportation; therefore, talking the pivotal positions, their profits and importance demand attention. Affected by the changing prosperity, the Product Life Cycle (PLC) of electronic industry is short and thus easily to be eliminated. The amount and the price of the products will receive the impacts from the international markets. Furthermore, under the stress of globalization, establishing and managing the Credit Rating Index and the Financial Commitment to Performance are significant, since the electronic enterprises cannot retrieve the financial statements from the clients like the financial organizations and credit evaluation units do so as to evaluate and analyze the clients' credit situations and abilities of paying the debt.

Current the studies on the analyses and the establishing of Credit Rating Index are not many. For the clients as listed companies, because of being controlled by the Financial Supervisory Commission (FSC), the chance of their violating the contract is relatively low. However, having difficulties in receiving the financial statements, the enterprises must evaluate the credit situations of the clients on the basis of their check transactions (by consulting the financial units), the business performance, and the credit personnel's past experiences and judgments. In this evaluation, one would ignore the property background, the financial structure, the work experience and qualifications, and the ability to hold the asset. Under the global distress, the model of evaluating the risks of the small and medium industries in Taiwan must be established in order to develop a mechanism of managing the credit risks and to keep these enterprises profiting. Therefore, establishing the credit evaluation rating index serves as the topic of this research to find the key influence.

This research takes the examples from the electronic industries to analyze how a credit rating index could be developed as an objective standard for the financial organization and credit-evaluating units to establish a Credit Policy. According to the different results of the investigation, different credit limits could be granted to the different clients. In this model, the risks of bad debts could be avoided. The goals of this research are as following:

1. On the basis of the structures of electronic enterprises, taking the past literature and the methods of the credit-evaluating units as the references, this research is to establish a model for the electronic enterprises to evaluate the credit situations of their clients.
2. Om the basis of the financial and non-financial data of the electronic industries, this research analyzes the reasons why the small and medium enterprises would violate the contract. The result of this analysis is contributive to the establishing of credit rating index.
3. Calculating the credit rating index and the clients' credit risks, this research provides a principle and references for the electronic industries and the credit-evaluating unit.

LITERATURE REVIEW

The Introduction to the Electronic Industries

Taiwan electronic industries, with the high-quality human resource, the huge investment and flexible and fast integration of resources, take the central position in global electronic OEM system. Unlike traditional industries, the electronic industry holds the special position because of its short PLC, its unstable amount of stock and fund. With high risk, on the wave and with the intense investment, this industry must rely on huge fund to invest on the renewal of products. The structure of electronic industry, according to IEK, includes the material and the component factories in the mainstream, the equipment production, component model and the accessory factories in the middle reaches, and the service and the electronic OEM of a peculiar brand in the downstream (Lau, 2006). In addition, the products can be classified into eight categories: (1) consumer products and the components, (2) the computer equipment and components, (3) the communication equipment and components, (4) convey and control products, (5) the semiconductor products and components, (6) the cable and connector, (7) the monitor and storage equipment, (8) other products.

Credit Rating Index

Credit rating is an evaluating system for the various credit situations of a criticized organization. It is presented in simple signs. The evaluation is to understand whether the enterprise has a sound structure of finance and thus the ability to pay the debt, on the bases of leveling the debtor and analyzing the Default Risk. This evaluation reduces the imbalance of information and the cost of non-professional personnel collecting the data, so it achieves in the pre-caution. Most credit evaluations are related with the specific debt execution. The execution of the debt also considers the criticized side by its ability to pay the debt in the future. The method and model of this evaluation would take the prosperity of the market into consideration in the past. Following the financial changing and the risk management, especially when the evaluation of credit is to reflect the enterprise's transaction with a specific debt, an ideal evaluation should be independent from the prosperity cycling.

Chen, Chiang, Lai (2003) believe that credit evaluation is a system of background-checking evaluation, making use of statistics and setting up a leveling form. The factors for the leveling include the financial situation, the management ability, and the industry characteristics. Tsai Ming Shi states that the credit evaluation of an enterprise is a series of analyzing the enterprise's credit strength and of leveling (or scoring) the criticized company. Lin Chia Rong (2000) classifies the evaluation as Qualitative Model, which qualifies the evaluation into 5P and 5C principles: People, Purpose, Payment, Protection, and Perspective. 5C include Character, Capability, Capital, Collateral, and Condition.

The Relative Literature on the Financial Organizations' Credit Rating

Treacy and Carey (2000) points out that the banks in the US have designed the credit evaluation. The risks to be examined in this evaluation are reliable financial statements and analyses, the profiting, the total assets, the analysis of the enterprise and the enterprise positions, and the guarantee and the managements. Kim and Sohn (2008), processing data of

the Korean enterprises from 2000 to 2004 by multivariate analysis to build a credit rating index (according to the enterprises' characteristics, reserved profit, and the shareholder's rights), find that the high reserved profit causes the relatively high credit rating.

Chen (2005) researches on the small and medium enterprises in New Taipei City and comes to the factors of their credit situations: The more capital of the financial factor is there in an enterprise, the larger the management will be. The insufficient capital will result in the financial danger if the risk takes place in the enterprise. The result will cause the contract violation.

In the variables of the non-official terms, more enterprises to be connected with the banks indicate that the bank has not much confidence on the enterprises and thus is not willing to expand the loan credit. Therefore, the enterprise has to borrow the money from many banks and thus there is a higher chance for the enterprise to violate the contract.

The proportion of the enterprise's performance and the loan from the bank should be limited into 50%. More than this range, the violation of the contract is more possible. The asset from the stock sharer can also be classified as the profiting, affecting the violation of the contract. The higher this rate is, the more chance the client would violate this contract.

The Credit Rating Index of the Electronic Enterprises on Their Clients

The bad debt has great influence on the financial disaster in addition to the overall environment and the management. In current years the global electronic industries have been under the process of transformation, which also forces the Taiwan industries to change. Unlike the financial organizations, the electronic industries cannot retrieve the complete information of their clients. They can only get the information from the financial units to know whether the clients' credit situations are reliable and thus to build the credit rate index for a sound evaluation, for example, the time of credit, payment, and the limit of loan. The credit rate index stands as the internal documents in the enterprise; therefore, this evaluation is different from one enterprise to another. This research takes two enterprises and their clients as the examples. The transactions to be examined here are: (1) the type of management (company, cooperation, or solitary), (2) capitalization, (3) the performance last year, (4) the cost of transaction last year, (5) the supposed payment in the final term, (6) the year of business, (7) the place of business, (8) the relationships, (9) payments, (10) credit limit.

The credit rate index made by the electronic enterprise is focused mostly on the non-financial terms. To improve the financial index and eliminate the differences between the indexes made by different enterprises (which makes the data untrue), this research combines the data from the financial units, the credit-evaluation units and the current electronic enterprises to extract the proper index for the current electronic enterprise to evaluate their clients. This index serves as the principle and direction for the future.

METHODOLOGY

The ANP

The analytic hierarchy process (AHP), as proposed by Saaty (1980), has received widespread attention and been applied to problems as diverse as decision analysis, forecasting, strategy formulation, and prediction of voting behavior (Zahedi, 1986). Multi-criteria (MCRA) resource problems involve allocation of limited resources to different activities keeping in mind many conflict criteria. The AHP has emerged as a useful decision making technique for solving MCRA problems (Wedley, 1990) (Schoner and Wedley, 1989) and has been widely used in multiple criteria decision making (MCDM) to evaluate/select alternatives (Ou Yang et al., 2008). However, users of theAHP must assume that the information sources involved are non-interactive/independent which is not realistic in many real-world applications (Ou Yang et al., 2008). In order to solve this problem, Saaty (1996) proposed a new MCDM method, the ANP, to overcome the problems of inter-dependence and feedback between factors and the alternatives.

The ANP is a nonlinear structure, while the AHP is hierarchical and linear, with the goal at the top and alternatives at lower levels (Saaty, 1999, 2001, 2003). The ANP is an extension of the AHP; indeed, it is the general form of the AHP (Ou Yang et al., 2008), and ANP is presented as a potentially valuable method to support the selection of projects in research and development environments (Meade and Presley, 2002). ANP is a method able to analyze or assess relevant decision-making problems under complex inter-dependence relationships within the decision making and factors levels (Saaty, 1996, 2001, 2003; Meade and Sarkis, 1999). There have been many studies using ANP in selection, assessment, and sorting decision-making models of dependent relationships (Cheng and Li, 2005; Eddie et al., 2005; Wolfslehner et al., 2005;Wu and Lee, 2007; Yurdakul, 2003).

Moreover, the ANP has been successfully applied in many practical decision-making problems, such as project selection (Meade and Presley, 2002; Lee and Kim, 2000). Wu and Lee (2007) used the characteristics of ANP to assist in the assessment and selection of knowledge management strategies. When evaluating project problems, group opinions should be collected to determine the inter-dependence relationship among factors, which is very important in considering project problems (Lee and Kim, 2000). Application of the ANP method in the assessment of alternative programs considers problems of practical respects of inter-dependence relationships between various programs and factors and evaluates the selection results, in order to achieve the requirements of the program selection goals (Saaty, 1996, 2001, 2003). This research is to identify the fact that various strategies of credit rating indicators take place according to different motives. Therefore, the making of those strategies is not out of single motive, when the inner and outer motives are highly inter-dependent. This research, taking the vantage points of ANP, analyzes the models of the decision making of credit rating indicators, the result of which might have found the essential connection between the motives and the strategies. The ANP method contains two parts: (1) one is composed of control clusters of network and motives for inter-dependence relationship control; and (2) another is composed of the inter-dependent relationship network between the elements and the clusters (Saaty, 1996). Hence, different structural patterns can be established for ANP problems according to different problem types, and in a network structure, the

importance of factors determines the importance of alternative programs,which in turn affects the importance of factors.

In addition, the ANP method defines the scope of decision-making problems by the modeled planning groups. Based on the relevant fields, experts from related fields are invited to form decision-making groups of five to 15 people (Saaty, 1996). The ANP method has five steps and the details of the steps involved may be found in Ou Yang et al. (2008).

The operation of the credit rating indicators decision-making model established in this study is divided into four stages: (1) collection of experts and scholars for questionnaire design and survey data, construction of problem hierarchy, and inter-dependence model; (2) construction of pairwise comparison matrices and calculation of eigenvalues and eigenvectors; (3) construction of supermatrices; and (4) calculation of factors importance weights and evaluation of the most competitive credit rating indicators decision making (Saaty, 1996; Meade and Sarkis, 1999; Cheng and Li, 2005; Wu and Lee, 2007; Lin and Wu, 2008).

EMPIRICAL RESULTS

This research deals with the past researches on the financial organizations and the credit-evaluation units, inviting seven experts who had participated in the activities of credit evaluation and setting up the questionnaire in two periods. The first period is to design three dimensions and the relativeness not only of them but also of the dimensions and the factors. The initial questionnaire for the samples is compared with the most suitable dimension and the factors. The second period of questionnaire, on the basis of the first, analyzes what the experts believe as the best factors and dimensions for the credit rate index. The initial design of the 3 dimensions and the 18 factors are conducted into the 18 principles as the basis for this research, as shown in Table 1, The Clients' Credit Evaluation Principles.

Table 1 The Principles for the Client's Credit Evaluation

Dimension Major Principle	Factor Monor Principle		Definition
A. The Scale of the Enterprise	A1	Capital	The amount of the money the enterprise registers in the government.
	A2	The years	The years since the enterprise has been established.
	A3	The structure of the enterprise	Whether or not the enterprise has the subordinate branches.
	A4	The style of the enterprise's organization	The structure of the holdsharer: solitary, cooperation, or the connection.
	A5	The management of the leader	The leader's ability in dealing with the production, sales, human resource, research and the finance.
B. Financial structure	B1	The profiting capability	The capability of increasing the property and decreasing the debt.
	B2	The cash current	The flow of the cash into or out of the enterprise.
	B3	The level effect	The balance between the risk, debt and the assets.
	B4	The bridge loan of the stocked products	The sales of the stocked products in a peculiar period of time.
	B5	The bridge loan of the supposed payment	The supposed payments between the production and the receiving.
	B6	The loan to sales ratio	The proportion between the business performance and the loan.
C. The characteristic of the enterprise	C1	The management environment	The environmental factors the enterprise must face, which also influence other enterprises.
	C2	The competitiveness	In the market with competition, the enterprise must effectively provide the products and services so as to make the opportunity of profiting.
	C3	Major client	The value of the customer, different clients have different contribution to the enterprise's profiting.
	C4	The marketing of the products	Whether the products are produced under the considerations of the market requirement and the enterprise's situations
	C5	The potential of the product development	The performance of the products in the future.
	C6	The changing prosperity	The turbulence of the economic situation.
	C7	The inventiveness of the products	Whether the newly-invented products would be accepted and applied in the market.

The Initial Questionnaire for the Credit Evaluation

This research sifts out the initial dimensions and factors. The interviewed people have to be the supervisors of the electronic enterprises for at least 3 years, and the experts on the credit evaluation. The relative analysis of the factors and dimensions has the result that the experts believe that the C dimension (environment for the management) is not relative with the client's credit rate index in electronic industries. Therefore, this research rules out this dimension and holds the index A dimension (the scale of the enterprise) and the B dimension (financial structure) and their 11 factors. On the basis of these factors and dimensions received from the initial questionnaires, this research design the second phase of expert questionnaire.

The Weight of the Credit Rate Index and the Leveling Analysis

This research on the second phase of questionnaire proceeds the analysis of the interactions of the dimension and the factors, with the experts answers for the questionnaires. The qualifications for those experts are the experiences in the electronic enterprise as a supervisor for at least 3 years and the personal working in the credit evaluation, which are helpful to learn the interactions of the principles and the relative wrights. The client's credit rate index and the leveling analysis show that "the scale of the enterprise" and the "financial structure" form the index for the credit evaluation when compared with their relativeness.

The consistency of the questionnaire in this research examines the consistency of the answerers. When C.I. < 0.1, the answerers are inclined to be consistent, or they have to do the questionnaire again, or revise their answers. In addition, if the consistency is no more than 0.1, ($C.R. \leq 10\%$), which means that the analyzer's mistake is within the rational range when comapring the weights since the result has the consistency. (As shown in Table 2)

Table 2. The Credit Rate Index C.I.

Credit Rate Index		C.I.	R.I.	C.R
A1	The Capital	0.0898	1.12	0.0802
A2	The years	0.0884	1.24	0.0713
A3	The structure of the enterprise	0.0227	0.9	0.0252
A4	The styles of the organization	0.0656	1.24	0.0529
A5	The leader's management	0.0396	1.12	0.0354
B1	The profiting capability	0.0759	1.12	0.0678
B2	The cash current	0.0543	1.24	0.0438
B3	The level effect	0.0949	1.12	0.0847
B4	The bridge loan of the stocked products	0.0988	1.12	0.0882
B5	The bridge loan of the supposed payments	0.0884	1.12	0.0789
B6	The loan to sales ratio	0.0926	1.12	0.0827

The result of this research, according to the credit evaluation index, shows that the experts believe that the electronic enterprises evaluate the clients' credit situation with the dimension more of "financial structure" (the weight is 0.62709) than of the "scale of the enterprise" (the

weight is 0.37291). As for the factors, the sequence of the importance is the "cash current" (the weight is 0.19398), the "profiting capability" (the weight is 0.18119), the "payment" (the weight is 0.16492), the "the structure of the enterprise" (the weight is 0.11066), the "storage exchange" (the weight is 0.10468), the styles of the company and organization (the weight is 0.08018), the owner's leadership (the weight is 0.04513), the level rate (the weight is 0.02410), the capital (the weight is 0.03103), the management (the weight is 0.02410), and the years of business (the weight is 0.02119). As shown in Table 3, the weight more than 10% includes 5 factors. Except for the structure of the enterprise, which does not belong to the scale of the enterprise, the other four factors belong to the financial structure. Among them, the cash current, the profiting capability, and the payment are more than 15%.

Table 3. The weights of the factors in credit rate index

Factors		Dimensions	Weight	Proportion
B2	The cash current	Financial structure	0.19398	19.40%
B1	The profiting Capability	Financial structure	0.18119	18.20%
B5	The bridge loan of the supposed payments	Financial structure	0.16492	16.49%
A3	The structure of the enterprise	The scale of the enterprise	0.11066	11.07%
B4	The bridge loan of the stocked products	Financial structure	0.10468	10.47%
A4	The styles of the enterprise's organization	The scale of the enterprise	0.08018	8.02%
A5	The leader's management	The scale of the enterprise	0.04513	4.51%
B3	The lever effect	Financial structure	0.04294	4.30%
A1	The capital	The scale of the enterprise	0.03103	3.10%
B6	The loan to sales ratio	Financial structure	0.02410	2.41%
A2	The years	The scale of the enterprise	0.02119	2.12%
			Sum=1	100%

CONCLUSION AND IMPLICATION

This research takes the financial units and the credit evaluation organizations as the references to analyze the factors in the credit evaluation. With ANP questionnaire, and the interviewing with the experts, this research figures out the interactions of the principles through ANP Super Decisions. As the results have shown:

1. The financial structure is more than the scale of the enterprise: in the client's credit rate index, the financial structure is 0.62709, more than the scale of the enterprise, whish is 0.37291. Among them, the cash current, the profiting capabilities, and the payment exchange are more than the scales of the enterprise, more than the other factors by 50%.

2. The characteristic of the enterprise does not have much influence. The experts believe that in the proceeding of the credit evaluation, the environment, the competitiveness, the major client, the marketing of the product, the product potential, the changing of the prosperity, and the inventiveness of the product (all of which can be classified into the characteristics of the enterprise) do not have much affections. This result is different from what the credit evaluation organizations have anticipated.
3. Current credit evaluation, as The Banks of Associations of Republic of China has set up as SME Credit Scoring in 1987, should include the financial situation (40%), management (40%), the enterprise characteristic and expectations (20%). This research shows that this index is not proper for the electronic industry in Taiwan.

In the past, the electronic industries evaluate the clients' credit situations through the data provided by the financial organizations, ignoring the fact that even the client with normal check transaction is not necessarily in good credit situation and with good management. Especially in the electronic industry, the payment takes place after the exportation of the products instead of using promissory note. In addition, when the payment is lasted for more than 180 days, the contract is inclined to become a bad debt, creating greater risks for the industry. However, when the industry imitate the working of the financial organizations, the cost for the management would be increase.

Many enterprises are undergoing the management of groups. Sometimes the clients have the financial threats, with bad management and investment. So, in addition to the credit situation, the financial and non-financial terms of the enterprise should also be taken into consideration. The current credit index for the electronic industries in Taiwan tales the scale of the enterprise as the major concern, which stands not as the major dimension of this research. The possible reason is that the analyzing factors for the scale of the enterprise are easier to be retrieved with their statistic data. The enterprises apply this easy information as the major concern for the evaluation. In addition, in the research on the credit evaluation, most analyses on how the financial organizations evaluate the clients ignore the individual enterprise's applications of the credit rate index. The high cost of the eternal evaluation also cannot help the urgent need of information. In addition to reviewing the past literature, this research also includes the experts' opinion and the practical operation. It explores the evaluation of the credit condition to be applied in the management, creating the index with the correct prediction, contributive to the following research on similar topics.

REFERENCES

1. Cheng, E.W.L., & Li, H. (2005), Analytic network process applied to project selection, *Journal of Construction Engineering and Management*, 131(4), 459-66.
2. Eddie, W. L., Cheng, H. L. & Ling, Y. (2005), The analytic network process (ANP) approach to location selection: a shopping mall illustration, *Construction Innovation*, 5(2), 83-97.
3. Kim, Y. & Sohn, Y. (2008), Random Effects Model for Credit Rating transitions. *European Journal of Operational Research*, 184(2), 561-573.
4. Lee, J. W. & Kim, S. H. (2000), Using Analytic Network Process and Goal Programming for Interdependent Information System Project Selection. *Computers & Operations Research*. 27(4), 367-382.
5. Lee, Y. T., Wu, W. W., & Tzeng, G. H. (2008) An Effective Decision-making Medthon Using a Combined QFD and ANP Approach. *WSEAS Transactions on Business and Economic*s, 12(5), 541-551.
6. Lin, C. T. & Wu, C. S. (2008), Selecting marketing strategy for private hotels in Taiwan using the analytic hierarchy process, *The Service Industries Journal*, 28(8), 1077-1091.
7. Lin, C. Y. and Kuo, T. H. (2007), The mediate effect of learning and knowledge on organizational performance, *Industrial Management & Data System*s, 107(7), 1066-83.
8. Meade, L. M. & Rogers, K. J. (1997), Enhancing A Manufacturing Business Process For Agility. Portland International Conference On Management & Technology, 638-641.
9. Meade, L. M. and Presley, A. (2002), R&D project selection using the analytic network process, *IEEE Transactions on Engineering Managemen*t, 49 (1), 59-66.
10. Meade, L. M. and Sarkis, J. (1999), Analyzing organizational project alternatives for agile manufacturing processes: an analytical network approach, *International Journal of Production Research*, 37 (2), 241-61.
11. Saaty, R. W. (2003), Decision Marking in Complex Environments Software for Decision Marking with Dependence and Feedback, Pittsbugh. PA.
12. Saaty, R. W. (2003), The Analytic Hierarchy Process (AHP) for Decision Making and the Analytic Network Process (ANP) for Decision Making with Dependence and Feedback, Creative Decision Foundation.
13. Saaty, T. L. & Takizawa, M. (1986), Dependence and independence: from linear hierarchies to nonlinear networks. European Journal of Operational Research, 26(2), 229-237.
14. Saaty, T. L. (1980), The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation. New York: MeGraw-Hill
15. Saaty, T. L. (1996), Decision Making with Dependence and Feedback: The Analytic Network Process. Pittsburg h: RWS Publications.
16. Saaty, T. L. (1999), Fundamentals of the analytic network process, Proceedings of the 5th International Symposium on the Analytic Hierarchy Process, Kobe, Japan, pp. 12-14.
17. Saaty, T. L. (2001), Decision Making for Leaders, RWS Publications, Pittsburgh, PA.
18. Saaty, T. L. (2003), Decision-making with the AHP: why is the principal eigenvector necessary, *European Journal of Operational Research*, 145 (1), 85.
19. Schoner, B. & Wedley, W.C. (1989), Ambiguous factors weights in AHP: consequences and solution, *Decision Science*, 20 (3), 462-75.
20. Treacy, W. F. & Carey, M. S. (2000), Credit Risk Rating Systems at Large US Banks. Journal of Banking & Finance, 24,(1-2), 167-201.
21. Wedley, W. C. (1990), Combining qualitative and quantitative factors-an analytic hierarchy approach, *Socio-economic Planning Sciences*, 24 (1), 57-64.
22. Wolfslehner, B., Vacik, H., & Lexer, M.J. (2005), Application of the analytic network process

in multi-criteria analysis of sustainable forest management, *Forest Ecology and Management*, 207 (1/2), 157-70.

23. Wu, C. R., Chang, C. W., & Lin, H. L. (2008), A Fuzzy ANP-based Approach to Evaluate Medical Organizational Performance. Information and Management Sciences, 19(1), 53-47.
24. Wu, W. W. and Lee, Y. T. (2007), Selecting knowledge management strategies by using the analytic network process, *Expert Systems with Applications*, 32(3), 841-7.
25. Yurdakul, M. (2003), Measuring long-term performance of a manufacturing firm using the analytic network process (ANP) approach, *International Journal of Production Research*, 41 (11), 2501-2529.
26. Zahedi, F. (1986), The analysis hierarchy process – a survey of method and its applications, *Interfaces*, 16 (4), 96-108.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

SUPERVISION AND PROTECTION OF E-DATA IN SENSITIVE INFORMATION SYSTEMS

Red. prof. dr. sc. Vladimir Šimović, Media University, Croatia
simovic.vladimir@yahoo.com

Matija Varga, mag. inf. univ. spec. oec., Media University, Croatia
maavarga@gmail.com

Doc. dr. sc. Marin Milković, Media University, Croatia
dekan@velv.hr

ABSTRACT

The paper shows the possibilities and ways to protect e-data in sensitive information systems such as financial information system and health information system. Nowadays, when the health information system and financial information system are developed and contain large amounts of data in the database, it is necessary to pay great attention to computer security, computer security mechanisms which enable the protection of electronic data, e.g. patient's diseases and clients' financial transactions. The aim of the paper is to present the best way of protecting e-data in the database from malicious people, i.e. malicious users of these systems, and from the deterioration and obsolescence of data storage media with the data important for the organization itself by making recommendations and showing the ways of their protection. This paper, among other things, explains the reason for creating a code of ethics for medical and health IT professionals. The information collected by using the questionnaire is shown. On the basis of this information, it can be concluded that most organizations use scanners and cameras to digitize documents, which are then usually stored in .pdf, .doc, .docx, and xml formats. The results of the research, which was conducted during the period of three weeks in 2012 on the sample of seven organizations, show that there is no organization that does not have a general policy of preserving the material in electronic form. A recommendation for the organizations is made in the conclusion – to back up electronic databases more often, or as many times as possible in the shortest period of time possible. The research presented in this paper, when it comes to collaboration in the development of the programs intended for preservation, shows that the most common form of collaboration is of local character.

Key words: sensitive information systems, financial information system, health information system, electronic data protection, database, methods of saving records.

INTRODUCTION

The paper shows the possibilities and ways to protect e-data in sensitive information systems such as financial information system and health information system. Nowadays, when the health information system and financial information system are developed and contain large amounts of data in the database, it is necessary to pay great attention to computer security, computer security mechanisms which enable the protection of electronic data, e.g. patient's diseases and clients' financial transactions. It is necessary to direct the end users of these

information systems when using health information systems and financial information system to the benefits that such systems provide. The users of such systems should be warned and use preventive measures so as not to abuse or use such data for the acquisition of personal gain at the expense of other clients or patients. The data relating to the case history of a person must be kept secret over the long term. Continuous implementation of the methods of preserving electronic records in the database of health organizations is necessary.

The aim is to present the best way of protecting e-data in the database from malicious people, i.e. malicious users of these systems, and from the deterioration and obsolescence of data storage media with the data important for the organization itself by making recommendations and showing the ways of their protection.

Paper tasks

The tasks set on the topic of "Supervision and protection of e-data in sensitive information systems" are as follows: to point out the possible dangers and threats for clients and patients who make part of the financial and health information systems; to show the possibilities of protection of the patient's and the client's electronic data; to advise on how to use the financial and health information systems; to influence the users of the financial information system and health information system in order to reduce the sensitive data leakage to the closer public; to mention and present the process of migration and preservation of electronic records; to state the reason for creating a code of ethics for medical and health IT professionals; to describe which combination of signs an optimal or strong password which will protect the electronic information system should consist of; to present systems for the supervision and control of the data flow in these information systems. Other tasks of the paper are to explain why it is needed and necessary to evaluate the health information system; to explain why it is necessary to secure the health information system from data loss; to explain who can change the data; to explain how the data confidentiality is realized in the health information system; to explain the functioning of the public health information system and financial information system; and to research which methods, procedures, modes, record formats, input devices, output devices and input-output devices are used by the observed organizations for the preservation of physical documents and records, and electronic documents and records.

Research methods used

For the paper entitled "Supervision and Protection of e-data in sensitive information systems" the following research methods will be used: survey, direct observation method, observation method, analysis, i.e. the method of content analysis, modeling, and interview. In the research methods of the survey and the interview, a sample consists of seven organizations – three organizations are engaged in public activity, two of them are privately owned, and two are educational organizations. This paper will further explain the protection of e-data in the health information system and the financial information system. The process of research using surveys and interviews lasted three weeks and was conducted in 2012. During that time the data on these organizations was collected. The results of the questionnaire data processing are shown by using figures.

THE PROTECTION OF E-DATA IN THE FINANCIAL INFORMATION SYSTEM

People with bad intentions find crashing into the financial information system most interesting. This is because financial institutions have large sums of money in their accounts. However, as the most of the IT professionals who deal with security of information systems claim, an intrusion into the financial information system has not been recorded. Moreover, no case of crashing into the financial banking information system has been recorded. The financial information system is under attack daily, but there are no major difficulties or more serious consequences of malicious people's crashing attempts.

Frequent audits and testing the system's permeability ensure a continuous increase in the security level and implementing the measures to reduce IT risks. At the level of the banking system, there are authorities which collect data about the most common attacks and incidents, and accordingly inform all the participants and require improvement of the system. In Croatia, hacker attacks are not as frequent as in the USA, and one of the reasons is a different language area (Bonić, 2011).

SQL and electronic data protection

SQL is a commercial query language for working with a relational database. Relational databases provide the greatest flexibility in data decomposition, which ensures a great advantage in planning the data distribution on individual system nodes. The standard structured query language is the most popular, best known and most widely used language. It is used to manipulate and manage data contained in the database. SQL server is a product and is closely linked to other servers and layers in a typical IT environment, which is based on the foundations of companies whose databases are in the question. The server is now not only used to store information about users. SQL server is extremely important because the work itself becomes more economical and much easier with it. There are several ways of protection in the SQL Server environment. One way is to provide an additional layer of security for sensitive data. Another way is to follow the rules, standards and laws related to data protection. The third way is related to the protection of the server objects on which the confidential user information and passwords for accessing linked servers can be found. The fourth way is to provide a controlled mode to define privileges for those modules that contain the code. SQL Server 2008, for example, enables encryption of all the data in the database by encrypting the pages of files that contain the database.

When it comes to the processes for managing data integrity, they should ensure accuracy, correctness, completeness or integrity of data in the database. Data integrity on SQL Server can be achieved by using certain constraints and triggers. Constraints are rules that apply to relations. This constraint defines the values allowed to be entered into an appropriate relation and to which range. In many applications, the rules for the preservation of data integrity are defined. However, it is not enough just to define the rules for the preservation of data integrity in an application, i.e. the interface available to the user, but appropriate constraints at the database level should be defined so that invalid data is not entered. The types of data integrity are entity, domain and referential. Entity integrity ensures that each type in a relation can be uniquely identified by a column. It is provided in SQL by using an index which is used to verify the existence of duplicate values. Primary key and constraints which are needed for uniqueness are applied when securing the entity integrity. Primary key and unique

constraints are quite similar and ensure that duplicate record in a relation does not happen. The differences constraints when using a primary key and a unique are as follows: (1) a table can contain one primary key, but X unique constraints can be defined in the table; (2) primary key can not take the null value, while the unique constraint can be defined for the column where the null values are allowed; (3) unique constraint does not use non-clustered index, while primary key uses clustered index. Domain integrity refers to the determination of allowed values for each column of the table. The type of data to be applied to a column in a relation presents one of the ways to ensure the domain integrity. With the domain integrity, CHECK constraint enables the restriction of values allowed in a column based on a logical attribute. Restricting by a foreign key the values allowed in the column are defined, but based on the content of the primary key. Domain integrity can be achieved through procedures, too. Referential integrity ensures and implements foreign or external key and CHECK. CHECK constraints can reference a number of columns in the same relation using the corresponding logical attribute. CHECK constraint can be a part of the create table command or it can be added to an already existing table. After the CHECK constraint is added to an existing table with data, it is checked with regard to the condition defined by CHECK constraint. If in a certain column we have much data, adding the CHECK constraint for that table can last for a while. In SQL, there is a way to skip data check when creating the new CHECK constraint into the existing table. The skipping is done with NOCHECK option. The constraint with a foreign key references the primary key, usually in the second relation in order to preserve the relation (of the weak entity). Referential integrity can be ensured procedurally by using triggers. External key constraint implies the following rules: for each record in the Buyer table there must be the corresponding record in the table Remaining_Part_Document; for each record in the tables Seller and Mark_document there must be the corresponding record in the table Remaining_Part_Document. Entering customer records with incorrect type of identifiers can undermine constraints related to the primary key, and the result is usually an error. Records in the Remaining_Part_Document can be removed if they are referenced by the records in the tables Buyer, Seller and Mark_document. The primary key of the record related to the remaining part of the document cannot be updated if there are records relating to the buyer, seller and mark of the document that it is referenced by.

The constraint with external key may enable the operations of cascading updating and deleting in interrelated relations. The operation of cascading deleting of the record should be used with caution. Deleting a single record can lead to the deletion of a large number of dependent blocks based on a series of tables and relations that are interrelated with foreign or external keys. In SQL, there are four options of settings which are related to the execution of cascade updates and deletions of a foreign key: a SET NULL setting; a SET DEFAULT setting; a NO ACTION setting; and a CASCADE setting. DML triggers are also a means of preserving the data integrity. Triggers allow defining more complex rules to preserve the data integrity in relation to the methods of declarative defining of the integrity and require additional calculations. Triggers are used for preventing faulty commands such as insert, update, and delete, when displaying user-defined messages of an error occurrence and during cascading changes in related tables in a database which cannot be achieved by using the external key.

The protection from an unauthorized access to the e-database

Databases must be protected from an unauthorized access. In addition to physical protection, there is a software mode of protection, where the software is installed in the system for database management. It limits the work with the database, i.e. the work of users who have physical access to a computer or computer terminals. There are several ways to protect databases, such as user identification, various mechanisms of protection, and authority. When it comes to protecting the database by user identification, it is known that each database user has his or her own *username* and a *password* known only to them. The user must present a valid username and password in the system for database management, thus proving their identity. If the user fails to enter a user name and password that correspond to the list into the system for database management, the system for database management refuses to give permission to work with the database. A large number of the systems for database management can be controlled via the Internet. Database can also be accessed from the remote computer, which can be located anywhere in the world. This advantage is also a disadvantage because it opens another door for malicious people to get unauthorized access to certain data. How to protect the database which can be accessed on the Internet? Temporarily, it can be protected by turning off the network system capabilities for database management. Thus, only local users (developers) could access the database, i.e. local network clients. The access to the database may be allowed only to some external users, but only with the identification of the client using encrypted communications such as *ssl/ssh*, double keys, etc. As for the *views*, the user may be given the right to access only a certain part of the data. Other parts of the database are unavailable for a particular user.

Protecting the database by giving authorization defines what the user can do with the data from the database, which is at disposal. The authorization for the protection can be *read/select, update, insert* and *delete*. The database management system must "memorize", i.e. have a stored list of authorizations for every user and every relation from the specific views. If the user attempts to perform an activity he or she is not authorized of, the database management system will not perform it, but it will print out a warning that the user is not authorized to perform these activities. In most cases, a developer or database administrator is responsible for the protection of the database. Database administrator has a list of users, gives the possibilities of views, and regulates authorizations. Regular users do not have the possibility of regulating the authorities, but only the database administrator. The database should be properly supervised; the changes to the data should be analyzed according to the periods; and the actions of a person who wants to cause harm should be recorded. The functionality of the database management system can also be an indicator of its safety. Back ups or safety copies can also protect the data in the database. Nowadays, you can also use systems that automatically create a back up copy and system recovery, enable data archiving for more than five years, and eliminate the costs that are caused by human error associated with data storage. This type of protection provided by the systems for automatic back up and recovery system is better than backing up an entire database since the system returns only the data that have been changed.

The case of damaging the database and its recovery

With regard to the financial information system, numerous processes are present. The most common of them are purchase, sales, accounting, treasury, and travel warrants. Each of these

processes has its own sub-processes and activities at a lower level. The organizational structure of a certain organization is adapted to these functional areas, as well as jobs on the basis of which profits are generated. Damage to the database in the financial information system may arise due to the failure of the computer hardware (disc and other storage media) or due to an error in the systematic program support. The database may be damaged by the activity of malicious persons (called hackers), accidentally or unfortunately. Malicious people are most interested in the financial information system because e-money is present in this system.

Regardless of the causes and reasons of damage, the database must be returned in the condition of the preserved physical integrity. Under the database integrity we mean truthfulness and accuracy of information or data contained in the database. Problems with the integrity of the database in a broad sense cover all the protection measures whose aim is to prevent the entry of invalid data in the electronic database. Errors which occurred when entering or updating are responsible for the failure results in the base, while the software and system errors are the result of intentional input of invalid data to corrupt the database. The database is protected by constraints. Integrity rules present constraints of the database content for allowed conditions which provide mutual alignment of data of the database while entering, updating and deleting the data. Financial organizations work with the data available to them and in accordance with them, they make very important decisions. The consequences are serious if the data used in the finance department are not correct or have been changed by a malicious person or an attacker.

In order for the database to be restored, prior safety storing of the data from the base to a medium that is located outside the database is necessary. Therefore, the back up of the entire database is done periodically to a special medium, and all changes to the data in the database are recorded in the diary of changes (Varga *et al.*, 2007). On average, data back up from the base to a medium of a company is done by some companies every five days.

THE PROTECTION OF E-DATA IN THE HEALTH INFORMATION SYSTEM

Electronic data in the health information system should be protected from an unauthorized modification or alteration of data, destruction or disclosure of data by reading. When it comes to protecting electronic data in the health information system, family medicine doctors now have a problem with the applications which they use to access electronic data. Problems of applications for the health workers are as follows: (1) non-existence of compatibility between the licensed programs, which sometimes results in data loss during the transition to another application, i.e. a future information source. Doctors of family medicine and those who specialized in other fields today would need to participate more through their professional and expert associations in the evaluation of the quality of the programs (software) they work with. This could contribute to the quality of program functionality and it could be a guarantee that in the future, the program will be fully functional and applicable.

One of the tasks that users and maintainers of the health information system have is to assess system security, data integrity, protection and confidentiality of the data, with the purpose of a more efficient protection of the health information system and the increase of safety.

Electronic database access and the records in healthcare

In the electronic database of the health information system, the data can be accessed via the local workstation, i.e. using the terminal. Moreover, when we consider the application of the health information system, the data can be stored through the local workstation in the SQL e-database, which is located on the Windows 2008 Server. When the data is stored in the e-database, they can be accessed with a specific permission through different terminals, i.e. working places. When a physician works with a specific patient, he or she can access the data of the patient assigned to him, and the physician writes history on his computer, checks for previous diseases in the database, and stores and records the current condition of the patient in the database.

Some of the names of electronic records are as follows: EHR – electronic health record, EMR – electronic medical record, EPR – electronic personal record. The purpose of electronic records in health lies in the possibility of quick and reliable access to the data by health professionals. Such electronic records allow easy storage and the use of electronic data. Electronic health records enable easier function of monitoring the quality of work and administration. Records in electronic format enable faster and easier access to medical and clinical knowledge; they accelerate decision-making process; they indirectly facilitate communication with health insurance. Electronic records enable secure exchange of electronic data with other health organizations. For the physician, records in electronic form facilitate him or her getting to know the patient during his or her illness.

The ways of electronic data protection in health and recommendations for password setting

There are three basic ways of data protection in health: technical means of protection relating to the protection of computer hardware and software; legal means that relates to compliance with the Personal Data Protection Act, the Data Confidentiality Act, the Electronic Signature Act and the Telecommunications Act; and ethical means of data protection. Technical means of protection is ensured by the physical protection of the data carriers, by passwords, by network communication channels and encryption. In the health information system, ethical means of data protection is defined by IMIA (International Medical Informatics Association). Code of Ethics for medical and health informatics professionals must be clear, unambiguous and easily applicable in practice. Given that the IT field is in constant flux, the Code must be flexible to adjust to ongoing changes, without sacrificing the applicability of basic principles. The reason that the Code of Ethics for MHIPs is created instead of adjusting one of the codes designed for another group of IT professionals stands in the fact that MHIPs play a unique role in the planning and provision of health: a role which is distinct from that of other IT professionals working in different environments (International Medical Informatics Association, 2012).

With polyclinic activities, it is necessary to protect the doctor's reports, i.e. the data contained on it. Doctor's reports are protected in a way that each physician has his or her code or password, and can write or edit only their patients' reports, while they can only look at the others. Any physician can access the data in the database from any workstation or terminal. Administrators have far greater authority and rights. In certain application modules, administrators can access all the data and can provide or restrict authority or rights. Options

of a cardiologist in the observed information system (and the benefits) are as follows: (1) all the diagnostic laboratory reports are recorded in medical history or in a summarized discharge letter; (2) they have access to the previous reports of the same patient (archives); and (3) have Internet access (Inge and Mihalić, 2012). In the health information system, the data is protected by creating safety copy or back up daily. In the process of backing up, electronic data is stored on the server and three external storage media including: hard disk, DVD, and CD. To protect the electronic data effectively, anti-virus protection on the Internet is automatically updated. Since the patient data must not be lost in order to protect and secure the health information system, in addition to back up and anti-virus protection using firewall that filters communications packages and controls the traffic towards the local network and UPS (Uninterruptible Power Supply). UPS is an uninterruptible power supply system which is used in the health information system. The purpose of such a system is power supply of especially important information equipment with appropriate quality DC or AC voltage. It is widely known that the DC power systems are used to supply the most demanding consumers, which require an uninterrupted voltage, and in the case of power supply or additional aggregate supply failure.

When talking about the data integrity, in most departments only currently active physician can modify and print out their reports, while other reports can be only browsed. When one needs to print out a report, the printing can be done by the administrator. Administrator can print out any report.

In order to protect the health information system, it is necessary to ensure data confidentiality. Data confidentiality is ensured by passwords. In the health information system, it is strictly defined who is eligible to access a certain part of an electronic database, i.e. who has the authority to delete, create or update files and data stored in the file. Each physician must have a password to access a particular part of the application or a module. The password should be changed usually every month, and if necessary several times a month. An optimal password should be a minimum of seven characters. It is preferred for a password to contain a combination of uppercase and lowercase letters and numbers. It is by no means recommended to use first names, surnames, names of parents, children, date of birth, name of residence, street name, and the like for the password. It is not recommended to use for the password the same set of characters. Password change on the server or the application is done so that the user himself or herself changes the password. After the command for the password change is set, the user must first enter the current password, and after that the new password twice. In case the physician forgets the password, there is the administrator who will change it as needed. The password should not be written down on paper and put in a drawer in the office for security reasons and for the possibility that a third person comes to classified information about the patient.

When talking about a limited number of attempts to access the health computer system, the system must be adjusted to limit the number of possible accesses. If a user tries to access the health information system more than three times with a wrong password and username, the system must rejected them. The next desirable option to be set is the message of the last access to a particular part of the application or a particular module. The view of the last data access in the health information system should be provided in the form of dates, times, and names. Electronic data in the health information system can also be protected by locking the

passwords by the system administrator and by using stronger additional passwords or the dual password system.

Certain (reports) or the register in the health information system contain only numbers and never names (Inge and Mihalić, 2012).

The methods of preserving records in the health system – a case study

The owner of the data or databases in the health information system is the patient and his data should not be lost in any case. The patients' data must be permanently stored and archived. When it comes to archiving in the health information system, reports and discharge letters are automatically archived. If necessary, the data can be transferred from the old discharge letter to the new one. The information on the methods and ways of preserving electronic records and documents in the health information system for a longer period of time was collected using a survey called digitizing documents in the analogue form and the protection of e-documents (Stančić, 2005). The survey was filled in by an employee who is a part of the health information system and has sufficient experience in working with the observed information system.

Collecting the data by using survey and interview has led to following conclusions: the observed organization which uses the health information system (1) does not store materials or documents in digital form, but (1.1) is planning to store the materials and documents in electronic form. Based on the appointed secondary question 1.1.1., (what types of material and documents are planned to be stored by the company), the given answer was that the organization keeps records of all cases. The plan for the preservation of electronic documents of the observed organization is in the initial stage of construction (1.1.2.), and it plans to store the materials inside the organization itself (1.1.3.). In the question about the strategy of storing the materials and documents in electronic form, the interviewed employee says that the strategy is in the process of construction (1.1.4.) and that the construction of strategy for the preservation of materials and documents in electronic form is made with the help of external experts (1.1.5.). The observed organization intends to store the materials and documents which will originally appear in electronic form and to digitize existing materials and documents.

The key criterion that the observed organization considers as the main criterion for the selection of materials and documents for preservation is the legal obligation of their preservation. The interviewed and surveyed employee did not know (want) to answer the question of how much financial resources the observed organization is planning to invest into the system for the preservation of materials and documents in electronic form (1.1.8.).

The observed organization stores in the electronic form case files such as the documents of construction and adding on of a specific hospital. The organization's general preservation policy is in the process of developing a general conservation policy which includes the preservation of materials or documents in electronic form. The observed organization has a prescribed practice for (1) the transfer of preserved records from outdated formats into new formats of records (i.e. reformatting); (2) the update of the media (i.e., the replacement of depleted media with the new); (3) migration of records to a new type of media; and (4) emulation of outdated working environments or operating systems and other applications.

The observed organization has policies and defined programs for the preservation of materials and documents in digital form for a longer period of time. However, the problem is in the slow realization and implementation of activities for implementing the plan.

When it comes to collaboration, the observed organization has never cooperated with other companies or institutions to develop programs for the preservation of electronic records and documents. The employee who answered the questions and who is also the beneficiary of the health information system considers all electronic materials kept by the observed organization records. The observed organization has not been conducting any special preparations for the preservation of electronic materials which are considered records. The observed organization has not yet identified a problem, an obstacle or a threat to the integrity of electronic materials that might arise from the methods and techniques used.

Public health supervision system

Basic requirements for the public health supervision system are accuracy, timeliness, operability, originality and standardized quality. Accuracy refers to the continuous control and automaticity. Timeliness means the timely response of the public health supervision system without delay. Operability refers to data availability and flexibility in the creation of information. The public health information system includes the data from places where they occurred, for example from electronic health record and not from a special reporting form. Standardized quality includes a uniform terminology and international compliance (Kern, 2012).

RESEARCH ANALYSIS OF THE APPLICATION OF PROCEDURES FOR THE PRESERVATION OF ELECTRONIC MATERIALS AND DOCUMENTS

The questionnaire used in this paper is partly taken from the paper by Hrvoje Stančić entitled "Teorijski model postojanog očuvanja autentičnosti elektroničkih informacijskih objekata" ("Theoretical model of stable authentication preservation of electronic information objects") in order to collect data on organizations that are related to the preservation of electronic materials and documents. This study used a questionnaire consisting of 33 key questions. Besides these questions, the questionnaire contains a number of secondary questions. Each participant was an employee of the organization and it was clear already at the beginning that participants will not be in the position to answer every question. Mostly, the questions have been answered, except the questions about finances, due to the information sensitivity and value.

Table 1: Research analysis of the application of procedures for the preservation of electronic materials and documents

Questions and secondary questions	Answers: Organization 1	Organization 2	Organization 3	Organization 4	Organization 5	Organization 6	Organization 7
1. Does your organization preserve materials/documents in electronic form? (B)	No	Yes	Yes	Yes	Yes	Yes	Yes
1.1. Does your organization plan to preserve materials/documents permanently in electronic form?	Yes	-	Yes	Yes	Yes	Yes	Yes
1.1.1. What type of materials/documents do you plan to preserve?	Case files	-	All types of documents and materials which need to be preserved according to the Document Archiving Act.	All types of documents and materials which need to be preserved according to the Document Archiving Act and all other documents, order form, offer, book of products, concluded contracts, financial reports, etc.	Travel warrants, the decision on establishing the organization, statute, application letter	All types of documents and materials which need to be preserved according to the Document Archiving Act and all other documents. Register book, register, travel warrants, degrees and certificates on teacher training, i.e. file, files on school construction, attests, testing, services, school statutes, registries and files, contracts, formal decisions on weekly and yearly schedule of teacher's work obligations, decisions on setting up or breaking up working contracts, applications and notices of cancellation, etc.	All types of documents and materials which need to be preserved according to the Document Archiving Act and all other documents. Register book, register, travel warrants, degrees and certificates on teacher training, i.e. file, files on school construction, attests, testing, services, school statutes, registries and files, contracts, formal decisions on weekly and yearly schedule of teacher's work obligations, decisions on setting up or breaking up working contracts, applications and notices of cancellation, etc.
1.1.2. In which phase is the creation of the plan for the preservation of electronic documents?	In the beginning	-	In process.	We do not make plans for the preservation but we realize the preservation of documents in electronic	In the beginning phase since the organization is quite young.	We do not make plans for the preservation but we realize the preservation of documents in electronic	We do not make plans for the preservation but we realize the preservation of documents in electronic

Questions and secondary questions	Answers:						
	Organization 1	Organization 2	Organization 3	Organization 4	Organization 5	Organization 6	Organization 7
				form immediately.		form immediately.	form immediately.
1.1.3. Do you plan to keep materials/documents?	Inside the institution	-	Inside the institution	Of course, always.	Inside the institution	Inside the institution	Inside the institution
1.1.4. Do you have a developed strategy of preservation of materials/documents in electronic form inside your organization?	In construction	-	Yes, we do.	Yes, we do. You could say so.	In construction	Yes, we do. You could say so.	Yes, we do. You could say so.
1.1.5. The strategy of preservation of materials/documents in electronic forms has been/is being made:	Business secret	-	By ourselves inside the organization.	By ourselves inside the organization.	By ourselves inside the organization	By ourselves inside the organization.	By ourselves inside the organization.
1.1.6. Do you intend to keep materials/documents which are going to be originally created in electronic form?	Yes	-	Yes	Yes	Yes	Yes	Yes
1.1.7. Do you intend to digitize existing materials/documents?	Yes	-	Yes	Yes	Yes	Yes	Yes
1.1.7.1. Which of the following criteria will your organization consider main when choosing materials/documents for preservation?	Legal obligation of preservation	-	Legal obligation of preservation, saving space required for storage.	Legal obligation of preservation, saving space required for storage, historical, slow physical deterioration, improving access, commercial use of our own materials.	Historical / cultural importance, legal obligation of preservation, improving access, saving space required for storage.	Historical / cultural importance, legal obligation of preservation, improving access, saving space required for storage.	Historical / cultural importance, legal obligation of preservation, improving access, saving space required for storage.
1.1.8. What amount of finance resources is planned to be invested into the system for the preservation of materials/documents in electronic form?	Business secret (I do not know)	-	-	For now, it still cannot be estimated.	14000, 00 kuna	-	-
2. Describe which electronic material your organization preserves?	Case files and all the necessary documentation	CD	Disc, CD, microfilm.	All the documentation coming from the environment into our system and which goes out of the system into the environment.	More or less, all the material of the organization (order forms, maintenance plan, statute, members list, etc.)	Students lists with their personal data, their grades, contracts, registries, and all the documentation coming from the environment into our system in electronic form and which goes out of the system into the environment.	Students lists with their personal data, their grades, contracts, registries, and all the documentation coming from the environment into our system in electronic form and which goes out of the system into the environment.
3. Does your organization have a general preservation policy which includes the preservation of materials / documents in electronic	In the process of development	In the process of development	Yes. Preservation = obligational archiving according to	Yes. More or less all the documents coming into the company	In the process of development	In the process of development	In the process of development

Questions and	secondary questions	Answers: Organization 1	Organization 2	Organization 3	Organization 4	Organization 5	Organization 6	Organization 7
form?				the law.	and going out of it are stored in digital form and are preserved.			
4. Does your organization have a policy or prescribed practice for:	a) changing preserved records from outdated formats into new records (reformatting)	Yes	Yes	No	Policy? Yes	Yes	Yes	Yes
	b) refreshing the media (changing old media with new ones of the same type)	Yes	Yes	No	Policy? Yes	Yes	Yes	Yes
	c) migration of records on the new media type	Yes	Yes	Yes	Policy? Yes	Yes	Yes	Yes
	d) emulation of outdated work environments (operating systems and application)	Yes	Yes	No	Policy? Yes	Yes	Yes	Yes
	e) policy/ practice is in the process of development	In the process of development	I do not know	-	Policy is always in the process of development in that area	In the process of development	In the process of development	In the process of development
	f) something else	X	I do not know	-	-	X	-	-
5. Does your organization have a defined program or policy for the preservation of materials/documents in electronic form for a longer time period?		Yes	Yes	Yes	It is not clearly defined; however, the preservation of materials and documents is performed in electronic form.	No	No	No
5.1. In which year did the program/activity of preserving materials in electronic form start?		I do not know	1990	1995	From the beginning of digitalization of documents in the company.	2011	I do not know	I do not know

Questions and secondary questions	Answers:						
	Organization 1	Organization 2	Organization 3	Organization 4	Organization 5	Organization 6	Organization 7
				More precisely, from the time of the company establishment			
5.2. Is there any problem which influences the implementation of the program and activities?	Yes, slow implementation.	No	No	No	No	No	No
6. Do you use certain methods and/or techniques with the purpose of preserving materials in electronic form?	No	Yes	No	Yes	Yes	Yes	Yes
6.1. Generally describe the methods and/or techniques used for the preservation of materials in electronic form.	-	Materials which can be found on the server are protected against viruses, and materials are stored on several storage media.	-	Migration; changing file formats from one into another, depending primarily on the change of operating system and application program.	Photographing and scanning of the documents	Photographing and scanning of the documents and changing file formats from one into another. .XLS format into .XML format (program code).	Photographing and scanning of the documents, and changing file formats from one into another. XLS format into .XML format (program code).
6.2. If you do not preserve materials in electronic form, do you study/estimate certain methods and/or techniques as those which you might use in future?	Yes	No	No	We perform it	-	-	-
7. Have the other organizations or individuals collaborated (or collaborate or you plan collaboration) with your institution on the development of the preservation program?	Yes	No	Yes	No	No	No	No
7.1. Those were/are/will be:	All those who have experience in preserving electronic documents, graduated IT professionals, and other ICT experts.	-	Specialized agency	-	-	-	-
7.2. Is your collaboration (was/will be):	-	-	Of local character	.	-	Of local character	Of local character
8. Do you have some special preparations for the preservation of electronic materials you consider records (as different from the preservation of other electronic materials)?	Yes	Yes	No	Yes	Yes	No	No
8.1. If yes, please state which.	Preparing the medium for storage, and preparing appropriate input and output units.	Preparing the medium for storage (CD, USB)	-	Preparing the medium for storage (CD, DVD, USB memory, preparing the discs (internal and	Switching the records from the specific file on one storage medium to other data storage	-	-

Questions and	secondary questions	Answers: Organization 1	Organization 2	Organization 3	Organization 4	Organization 5	Organization 6	Organization 7
					external)).	medium.		
9. Has the program and/or the activity come to the point of testing or evaluation of any of the methods or techniques which you use?		No	No	No	No	Yes	-	-
9.1. If yes, what are the results/conclusions?		No	-	-	-	Good (Without a specific explanation)	-	-
9.2. Have you identified any problems, obstacles or threats for the integrity of electronic materials which would appear due to used methods or techniques?		No	-	No	-	No	No	No
10. Which of the following criteria are main criteria when choosing materials for the preservation? (C)		Legal obligation of preservation	Legal obligation of preservation and access improvement	-	Legal obligation of preservation and access improvement, and documentation which is necessary in future for tenders, i.e. the need for specific documents, etc.	Access improvement	Eased data access (availability)	Eased data access (availability)
11. Where do the materials you keep come from?		Mostly from the companies soliciting for tenders, and from governmental institutions.	From the parent body	-	From the parent body and from the environment.	From the parent body, and from other institutions (counties).	From the parent body, and from other institutions (counties, town, education and teacher training agency, etc.).	From the parent body, and from other institutions (counties, town, education and teacher training agency, etc.).
12. Which technique/method do you use for preservation? (D)		Archiving of all documents and storing the records of the archives on a CD. After a certain time, refreshing of the medium the important data is stored on is performed.	Storing the records of the archives on a CD.	-	Archiving of all documents and storing the records of the archives on a CD. After a certain time, refreshing of the medium the important data is stored on is performed.	Programming new software, i.e. improving the existing application, standardization of formats, migration, replication (records are copied without changes on the new generation media).	Standardization of formats, migration, replication (records are copied without changes on the new generation media).	Standardization of formats, migration, replication (records are copied without changes on the new generation media).
13. Which technique/method characteristics you use do you find good and why?		We consider it a good and useful solution to use the data registering program and JIT data finding for a certain case in	I do not know how to express myself.	-	-	The feature of preserving the object in its original form. Replication.	-	-

Questions and	secondary questions	Answers:						
		Organization 1	Organization 2	Organization 3	Organization 4	Organization 5	Organization 6	Organization 7
		a very short period of time, and finding out which department certain case is in and at which official.						
14. Do you use the hybrid model, e.g. a combination of two or more techniques/methods, like microfilming, scanning, and photographing?		Yes	Yes	Yes	Yes	Yes	Yes	Yes
14.1. Which model is that and how was it developed?		Scanning and photographing and earlier in the past microfilming was used.	Scanning and photographing	Scanning and photographing and earlier in the past microfilming was used.	Photocopying, microfilming, scanning.	Scanning and photographing, and conversion of .pdf formats into .doc and .docx formats.	Scanning and photographing, and conversion of .pdf format into .doc and .docx formats and conversion from .xls format into .xml format.	Scanning and photographing, and conversion of .pdf format into .doc and .docx formats and conversion from .xls format into .xml format.
15. In what way is the method/technique your organization uses different from other methods/techniques you tried/used before or do you know whether the other institutions are using them?		Easier navigation, retrieval and faster access to specific data.	There is no difference.	-	We did not use any other possibilities of preserving the records	We did not use any other possibilities of preserving the records	We did not use any other possibilities of preserving the records	We did not use any other possibilities of preserving the records
16. Have you taken into consideration possible impacts for the intellectual integrity (e.g. authenticity) of preserved materials when choosing the method/technique/strategy for preservation?		No	No	Yes	No	No	No	No
17. If you keep e-documents and materials, please state the record formats in question, according to the type of the preserved material (text, picture, video, web pages, etc.).		Text – .pdf, .doc, .docx, .odt Picture- .jpg, .jpeg. Sound- we do not preserve. Video- we do not preserve. Web pages- .hmtl, .css	Text – .txt, .pdf, .doc, .docx. Picture- .jpg, .jpeg. Sound- we do not preserve. Video- we do not preserve. Web pages- .hmtl, .css.	Text – .txt, .pdf, .doc, .docx. Picture- .jpg, .jpeg. Sound- we do not preserve. Video- we do not preserve. Web pages- .hmtl, .css.	Text – .txt, .pdf, .doc, .docx. Picture- .jpg, .jpeg. Sound- midi, mp3, mp4, wav, wave, cda, swa, voc. Video-avi. Web pages- .hmtl, .css. Bitmap (BMP), TIFF, GIF, HTML, FlashPix (FPX), TIFF compressed, DCX, PCX, RTF, CRV, PNG Mac: PICT, TIFF, JPEG, TIFF compressed, GIF, TEXT, HTML,	Text – .pdf, .doc, .docx, .odt Picture- .jpg, .jpeg. Sound- we do not preserve. Video- we do not preserve. Web pages- .hmtl, .css	Text – .pdf, .doc, .docx, .odt Picture- .jpg, .jpeg. Sound- we do not preserve. Video- we do not preserve. Web pages- .hmtl, .css Databases are preserved in .mdb format, .accdb format and .xml format.	Text – .pdf, .doc, .docx, .odt Picture- .jpg, .jpeg. Sound- we do not preserve. Video- we do not preserve. Web pages- .hmtl, .css Databases are preserved in .mdb format, .accdb format and .xml format.

Questions and secondary questions	Answers:						
	Organization 1	Organization 2	Organization 3	Organization 4	Organization 5	Organization 6	Organization 7
				FlashPix (FPX)			
18. Do you digitize materials?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
18.1. If you digitize, which devices do you use for that purpose?	Scanner and camera	Scanner and camera	Scanner and camera	Scanner, camera and video camera.	Scanner and camera	Scanner and camera	Scanner and camera
18.2. Which programs do you use?	Different programs, usually those that come in a package with the devices themselves (input units).	Different programs, usually those that come in a package with the devices themselves.	Different programs, usually those that come in a package with the devices themselves.	HP Photo & Imaging Software, NewSoft Presto! BizCard, Adobe Photoshop Elements, IRIS ReadIris Pro, Adobe Acrobat Reader.	HP Photo & Imaging Software, Adobe Acrobat Reader.	HP Photo & Imaging Software, NewSoft Presto! BizCard, Adobe Photoshop Elements, IRIS ReadIris Pro, Adobe Acrobat Reader.	HP Photo & Imaging Software, NewSoft Presto! BizCard, Adobe Photoshop Elements, IRIS ReadIris Pro, Adobe Acrobat Reader.
18.3. Which record format do you use when digitizing?	.pdf, .jpg, .jpeg, .gif, tools for the conversion of .pdf format into .docx format.	.pdf, .jpg, .jpeg, .gif, .doc, .docx.	.pdf, .jpg, .jpeg, .gif, tools for the conversion of .pdf format into .doc and .docx formats.	.pdf, .jpg, .jpeg, .gif, tools for the conversion of .pdf format into .doc and .docx formats.	.pdf for business documents. .jpg and .jpeg for pictures and photographs	.pdf, .jpg, .jpeg, .gif, .doc, .docx, .xls, .xml	.pdf, .jpg, .jpeg, .gif, .doc, .docx, .xls, .xml.
18.4. Which technical settings do you use when digitizing for the features like resolution and important pixel depth (color number) with picture materials, important sound depth with sound materials, etc.?	Settings that provide maximum image size to 6MB to avoid e-material taking too much memory space, i.e. data storage medium.	Default settings	Recommended settings.	Recommended settings.	-	Recommended settings.	Recommended settings.
18.5. Do digitized materials go through the additional processing (e.g. optical character recognition (OCR), color adjustment, contrast adjustment, additional rotation, cropping, etc.)?	They go through minimum processing to make e-records seem as authentic as possible.	No	No	Yes	No	Yes	Yes
18.6. Do you compress digitized materials?	Sometimes (very rarely).	Yes	Yes	Yes	No	Yes	Yes
18.6.1. If you compress, which is/are the format/s of compressed record you use?	.zip, .rar	.jpeg, and .zip and .rar.	.zip, .rar	.zip, .rar	-	.zip, .rar or the same format in compressed form .bmp	.zip, .rar or the same format in compressed form .bmp
18.6.2. Do you keep the original, uncompressed copy?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
19. Are the preserved materials described according to accepted standards?	Yes	No	Yes	Yes	No	Yes	Yes
20. Which methods of quality control do you use in the process of preserving electronic records? (E)	Own methods such as control of the time when the data was recorded on a specific data	I do not know.	-	Own methods such as control of the time when the data was recorded on a specific data	-	-	-

Questions and secondary questions	Answers:						
	Organization 1	Organization 2	Organization 3	Organization 4	Organization 5	Organization 6	Organization 7
	storage medium.			storage medium.			
21. How and where (physical location) do you store preserved electronic records?	In the archive. Electronic records are in the e-archive and on the record storage media according to the case code and name.	In the locked archive.	In the same building.	In the archive. Electronic records are in the e-archive and on the record storage media according to the case code and name.	In a room in our organization	In a room in our organization	In a room in our organization
22. On which media do you store preserved records?	CD-R, DVD-R, CD-RW, DVD-RW.	CD, USB.	Microfilm, CD-R, DVD-R, CD-RW, DVD-RW, USB.	Microfilm, CD-R, DVD-R, CD-RW, DVD-RW, USB.	On internal hard disc, DVD, CD, on external hard disc. The media is stored in locked drawers which are immovable in special locked rooms.	On internal hard disc, DVD, CD, CD-RW, DVD-RW, USB and on external hard disc. The media is stored in locked drawers which are immovable in special locked rooms.	On internal hard disc, DVD, CD, CD-RW, DVD-RW, USB and on external hard disc. The media is stored in locked drawers which are immovable in special locked rooms.
23. Do you make back-up copies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
23.1. How many copies do you make and how often?	I do not want to give this information.	Two copies, once a year.	-	The data is stored on a new disc every 3 days. Once every three days.	Once every two weeks a back-up is created, i.e. twice a month.	A copy is created every day, but for certain data only.	A copy is created every day, but for certain data only.
23.2. Where do you store them (physical location in relation to the placement of the original data)?	I do not want to give this information.	In the same building.	In the same building	In the same building	In the same building	In the same building	In the same building
24. Is there any kind of access constraint to the preserved records? (G)	There is a physical access constraint to the data which is on the media such as CD or DVD. It is not possible to access the server with important e-data without the password.	No	-	There is a physical access constraint to the data which is on the media such as CD or DVD. It is not possible to access the server with important e-data without the password.	Yes	Yes	Yes
25. Is the system the preserved records are in equipped by mechanisms for the access control?	The system is not equipped with special mechanisms for the access control; however, it can be determined who accessed the server	No	-	Yes	Yes	No	No

Questions and secondary questions	Answers: Organization 1	Organization 2	Organization 3	Organization 4	Organization 5	Organization 6	Organization 7
	when or who accessed the archive space where the media with stored e-data are.						
26. Are the preserved records available?	Only inside the institution	Strictly where they are preserved.	-	Strictly where they are preserved, only inside the institution, via specific software module.	The preserved records are available strictly where they are preserved and only inside the organization.	The preserved records are available strictly where they are preserved and only inside the organization.	The preserved records are available strictly where they are preserved and only inside the organization.
27. Is the system the preserved records are in connected to:	The server which is in the institution.	The server which is in the institution.	-	The server which is in the organization, intranet.	The server which is in the institution.	The server which is in the institution.	The server which is in the institution.
28. Is there a possibility of searching preserved records in the system?	Yes	No	-	Yes	Yes	Yes	Yes
29. Which categories can they be searched in?	Class, name, year, date, size, employee.	-	-	Class, name, year, date, file size, employee who created the document.	File size, date and file name.	File size, date and file name.	File size, date and file name.
30. Do you keep copyright materials in electronic form? (H)	No	No	-	No	No	No	No
30.1. Does your organization have copyrights for electronic form of the record?	No	-	No	No	Yes	For some records yes, and some no.	For some records yes, and some no.
30.2. Are the users allowed to perform any of the mentioned activities related to the preserved materials?	Printing	They are not allowed to do any of it	-	Printing, transferring materials on personal computer, transferring materials on local network.	Printing, transferring materials on personal computer, transferring materials on local network.	Printing, transferring materials on personal computer, transferring materials on local network.	Printing, transferring materials on personal computer, transferring materials on local network.
30.3. Does your organization use a system for electronic management for the control/ supervision/registering of creating copies?	Yes	No	Yes	Yes	No	No	No
31. In your estimation, what are the expenses of preserving records?	Business secret (I do not know)	Business secret (I do not know)	-	Business secret (I do not know)	I cannot estimate, minimum.	I cannot estimate; we try to make them minimum.	I cannot estimate; we try to make them minimum.
32. Please describe the categories of expenses for the preservation of records, id they exist (personnel, equipment, hardware, software, storage media, space and energy used, etc.)	Business secret (I do not know)	Business secret (I do not know)	-	Business secret (I do not know)	The expenses for the preservation of records are the storage space and energy used.	The expenses for the preservation of records are made by the storage space and energy used.	The expenses for the preservation of records are made by the storage space and energy used.
33. Which resources is the process of preservation funded from and how are they distributed?	Business secret (I do not know)	Business secret (I do not know)	-	Business secret (I do not know)	Business secret	-	-

Source: Created by the authors of the paper on the basis of data collected by questionnaire from the employees of relevant organizations and by the questionnaire from the paper by Stančić Hrvoje "Teorijski model postojanog očuvanja autentičnosti elektroničkih informacijskih objekata" ("Theoretical model of stable authentication preservation of electronic information objects"). Doctoral dissertation. Survey. Zagreb 2005.URL: http://bib.irb.hr/datoteka/244465.Ocuvanje_autenticnosti_e-informacijskih_objekata.pdf

On the basis of the table 1, we can see and compare the methods for the preservation of documents and materials, electronic documents and electronic materials which are used by the observed and surveyed organizations. Surveyed organizations are state-owned, privately owned and owned by the municipalities and towns. Employees who were surveyed have a university degree in economics (organization 1, 2 and 4), and in Information Technology (organizations 3, 5, 6, 7). The only problem that was present during the survey was finding experts in these organizations who have experience in long-term preservation of electronic materials and documents. Organization 1 is a part of the executive power in the Republic of Croatia, where the research was conducted. Organization 2 is a private company which specializes in import and distribution of fertilizers, agricultural products and feed additives. Organization 3 is an IT company for software development and troubleshooting of hardware for all types of computers. Organization 4 is a public organization owned by the municipalities and towns whose main activity is natural gas supply and distribution in a certain county. Organization 5 is an association which operates and performs activities in the field of finance and information technology for a longer period of time. Organizations 6 and 7 are educational organizations. On the basis of Table 1, the results of the research can be seen and it can be concluded that most organizations use a scanner and a camera to digitize documents; mostly, the digitized documents and electronic records are stored in .pdf, .doc, .docx, and .xml formats. When the safety of digitized documents and the possibility of the documents to be opened by malicious people is taken into account, it is best to store the digitized document in .odt format since the tools for opening documents and records in that format are less frequently used. The data collected from field studies indicate that representatives of the organizations that provided the data do not want to give in public the information on the amount of financial resources they would invest in the preservation of electronic materials and documents. The release of information from the plan of investing financial resources in the future is clearly not pleasant these days. Based on Table 1, the results of the company, i.e. observed organization, can easily be compared.

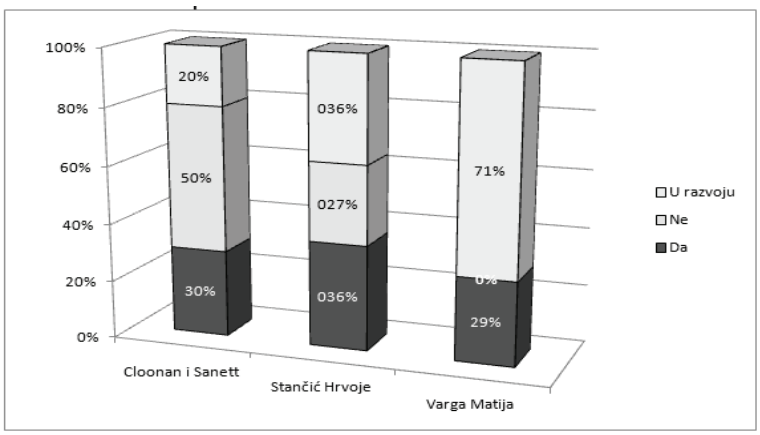


Figure 1: Does the institution have a general policy of preservation which includes the preservation of materials in electronic form?
Source: Created by the authors of the paper in MS Excel and on the basis of data collected by questionnaire from the employees of the observed organizations and the questionnaire created on the basis of the questionnaire from the paper by Stančić Hrvoje "Teorijski model postojanog očuvanja autentičnosti elektroničkih informacijskih objekata" ("Theoretical model of stable authentication preservation of electronic information objects"). Doctoral dissertation. Survey. Zagreb 2005. URL: http://bib.irb.hr/datoteka/244465.Ocuvanje_autenticnosti_e-informacijskih_objekata.pdf. Legend: In the process of development (U razvoju); No (Ne); Yes (Da); Cloonan and Sanett (Cloonan i Sanett)

Figure 1 indicates general preservation policy which includes the preservation of materials in electronic form. It is necessary to take into account that the time gap between the surveyed organizations and the conducted research between the first and the second case is five years, while the interval between the second and the last research presented in the first figure is 7 years. In the first case, in the figure 1, foreign institutions are the subject, while the other two figures show the results of local institutions or organizations. The research which was conducted over a period of one month and with a sample of 7 organizations, it is shown that there is no organization that has no general record and material preservation policy in electronic form.

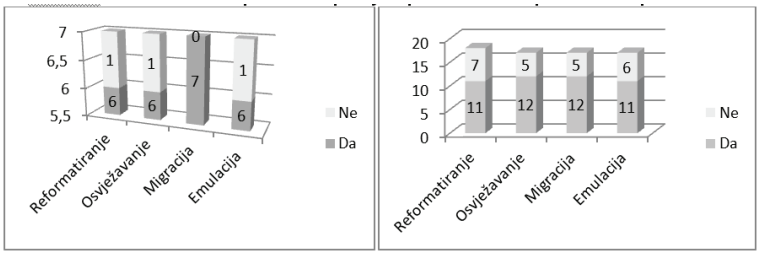


Figure 2: The existence of prescribed policy or practice for the preservation procedures
Source: Created by the authors of the paper in MS Excel and on the basis of data collected by questionnaire from the employees of the observed organizations and the questionnaire created on the basis of the questionnaire from the paper by Stančić Hrvoje "Teorijski model postojanog očuvanja autentičnosti elektroničkih informacijskih objekata" ("Theoretical model of stable authentication preservation of electronic information objects"). Doctoral dissertation. Survey. Zagreb 2005. URL: http://bib.irb.hr/datoteka/244465.Ocuvanje_autenticnosti_e-informacijskih_objekata.pdf
Legend: Reformatting (Reformatiranje); Refreshing (Osvježavanje); Migration (Migracija); Emulation (Emulacija); No (Ne); Yes (Da).

Figures 2 show the results of processing data collected on the basis of a questionnaire. We examined the existence of a policy or prescribed practice for switching the preserved records from outdated record formats into new ones (reformatting); refreshing the media (the replacement of depleted media with the new ones of the same type); migration of the records to the new media type; and emulation of outdated working environments (operating systems/programs). Of the seven surveyed institutions, seven of them responded to this question. All organizations are performing the migration process, which is shown in the left figure. If the collected research data from the research in the paper by Hrvoje Stančić and the research that took place in 2012 were combined, the size of the sample would increase to 18 organizations, and obtained results would be different (figure 2).

Table 2: The comparison of collaboration of organizations with other organizations

Type of collaboration	Cloonan and Sanett	Hrvoje Stančić	Matija Varga
International	11	3	0
On national level	10	4	0
Of local character	2	2	3
Of institutional type	0	5	0
Using the common space/equipment	1	0	0

Source: Created by the authors of the paper in MS Word and on the basis of data collected by questionnaire from the employees of the observed organizations and the questionnaire created on the basis of the questionnaire from the paper by Stančić Hrvoje "Teorijski model postojanog očuvanja autentičnosti elektroničkih informacijskih objekata" ("Theoretical model of stable authentication preservation of electronic information objects"). Doctoral dissertation. Survey. Zagreb 2005.(Modified)

Table 2 presents the comparison of results of three studies and shows the collaboration of the organizations with other organizations in the development of the preservation program. A five-year gap is between the first and the second research, and a seven-year gap between the second and the third research of the collaboration in the development of the preservation program. Based on the latest research, the most common form of collaboration in the observed organizations is of local character. Most of the observed organizations did not answer the question about collaboration between organizations, and three organizations have (will have) the collaboration of local character.

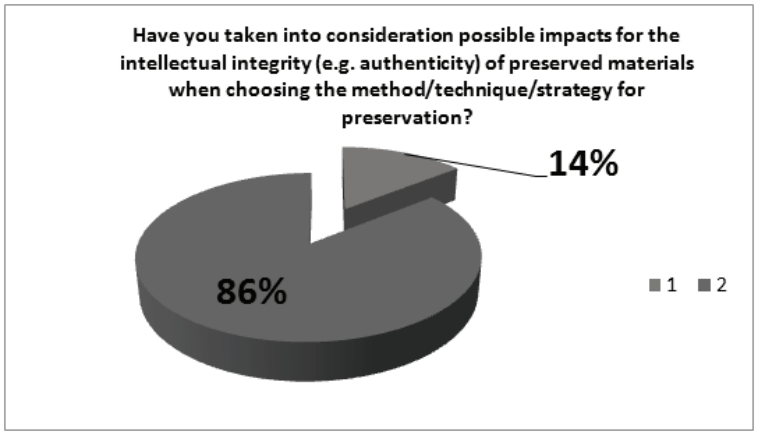


Figure 3: The influence on the intellectual integrity (e.g. authenticity) of the preserved electronic materials.
Source: Created by the authors of the paper in MS Word and on the basis of data collected by questionnaire from the employees of the observed organizations and the questionnaire created on the basis of the questionnaire from the paper by Stančić Hrvoje "Teorijski model postojanog očuvanja autentičnosti elektroničkih informacijskih objekata" ("Theoretical model of stable authentication preservation of electronic information objects"). Doctoral dissertation. Survey. Zagreb 2005. (Modified).

Figure 3 presents whether the organizations or employees, when selecting methods/techniques/strategies for preservation, have taken into account the possible impacts on intellectual integrity (authenticity) of preserved electronic materials. The question "Have you taken into consideration possible impacts for the intellectual integrity (e.g. authenticity) of preserved materials when choosing the method/technique/strategy for preservation?" the participants answered once with *yes* and six times with *no*.

CONCLUSION

The paper explains the reason for creating a Code of Ethics for Medical Health IT professionals. Based on the information collected by the questionnaire, it can be concluded that organizations mostly use cameras and scanners to digitize documents, and that the digitized document is usually stored in .pdf, .doc .docx and xml format. When the safety of digitized documents and the possibility of the documents to be opened by malicious people is taken into account, it is best to store the digitized document in .odt format since the tools for opening documents and records in that format, as well as the Linux operating system that supports Open Office, are less frequently used. The data collected from field studies indicate that representatives of the organizations that provided the data do not want to give in public the information on the amount of financial resources they would invest in the preservation of electronic materials and documents.

The results of the research, which was conducted during the period of three weeks in 2012 on the sample of seven organizations, show that there is no organization that does not have a general policy of preserving the material in electronic form. The recommendation for the observed organizations is to back up electronic databases more often, or as many times as possible in the shortest period of time possible. The research presented in this paper, when it comes to collaboration in the development of the programs intended for preservation, shows that the most common form of collaboration is of local character. Organizations, when selecting methods, techniques and strategies for the preservation of the records do not take into account possible impacts on intellectual integrity (e.g. authenticity) of preserved electronic materials (86% of the total number of surveyed representatives of the organizations), which is worrying or the participants did not understand the question well enough.

REFERENCES

1. Bonić, M. (2011), Bez IT sustava nije moguće poslovati, Poslovni dnevnik, Moja ulaganja, Dnevnik d.o.o., Zagreb.
2. Inge, H., and Mihalić, G. (2012), Informacijski sustav u poliklinici za prevenciju kardiovaskularnih bolesti i rehabilitaciju, Materijali s predavanja, Menadžment u zdravstvu, MEF.
3. Kern, J. (2012), Zdravstveni informacijski sustav – pojam i značenja, Materijali s predavanja, Menadžment u zdravstvu, MEF.
4. Lee, M., and Gentry, B. (2005), Microsoft SQL Server 2008, Kompjuter biblioteka.
5. Stančić, H. (2005), Teorijski model postojanja očuvanja autentičnosti elektroničkih informacijskih objekata, Doktorska disertacija, Anketa, URL:

http://bib.irb.hr/datoteka/244465.Ocuvanje_autenticnosti_einformacijskih_objekata.pdf. Zagreb.

6. Varga, M., Ćurko, K., Panian, Ž., Čerić, V., Vukšić, B. V., Srića, V., Požgaj, Ž., Strugar, I., Spremić, M., Pejić Bach, M., Vlahović, N., Jaković, B. (2007), Informatika u poslovanju, Sveučilište u Zagrebu, Zagreb.
7. "International Medical Informatics Association", URL: http://www.imia-medinfo.org/new2/ pubdocs/Craotian_Translation.pdf (accessed 18 March 2012).

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

A NOVEL INFRASTRUCTURE FOR DATA SANITIZATION IN CLOUD COMPUTING (RESEARCH PAPER)

Cheng-Yuan Ku, National Chung Cheng University, Taiwan, ROC
E-mail: cooper.c.y.ku@gmail.com

Yu-Siang Chiu ,National Chung Cheng University, Taiwan, ROC
E-mail: fishfly1115@gmail.com

ABSTRACT

Purpose- *In this extended abstract, we propose a novel infrastructure in cloud computing environment which assures the data sanitization after the customers decide to delete them.*
Design- *A mechanism with monitoring agents is suggested to watch the data usage over entire life cycle and assure the data sanitization in the end.*
Findings- *Security analysis and performance analysis will be done after the complete infrastructure is decided. We expect this mechanism should fulfill the security and performance requirements for cloud computing users.*
Originality/Value- *The emerging cloud computing technology needs the assurance of various security requirements, otherwise most of customers/organizations do not dare to adopt it. Our research proposes an infrastructure to solve one of the security problems, i.e. data sanitization. As well known, only after the security requirements of cloud computing could be managed and guaranteed, the prospects of the cloud services are brightening.*

Keywords: cloud computing, cloud services, information security, data sanitization, trusted third party (TTP), agent

INTRODUCTION

In recent years, as cloud computing becomes more and more popular, it has gradually drawn many enterprises' attention. Ironically, one of the major factors which lead the development of cloud computing is the previous economic recession. Due to the keen business competition and tight budget, enterprises need to find any possible ways to reduce cost. According to the National Institute of Standards and Technology (NIST), cloud computing providers offer services with three fundamental models (Mell and Grance, 2011):

- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)

Based on the individual need, enterprises can choose anyone, both or all of the above-mentioned methods to construct computing services for stakeholder. From the perspective of technology, cloud computing seems to be able to give a chance to divest infrastructure management of information systems and to enhance core competencies. However the potential security issues may hinder the cloud services from fast developing.

Even with the protecting mechanism in cloud, the attacker still can take various attack models to invade. Cloudburst virtual machine (VM) escape is an exploit method that enables

a guest-level virtual machine to attack its host (Kortchinsky, 2009). A method that prevents the VM escape has been proposed by security researchers (Ristenpart et al., 2009). In addition to the above-mentioned attack, one of the other major security considerations is data sanitization. Actually a deleted file only means the erased directory, not the file itself. This issue becomes even more complicate in cloud environment and still has no concrete solutions until now.

The trusted third party (TTP) and agent are two of the popular methods to solve many security issues. The TTP can act as a monitor and audit the performance of service providers for customers. An agent is generally developed to monitor network activity, collect information, act for a user or other program … and so on. For example, it can identify malicious network behavior that does not comply with the policy and send the alert to the managing center (Manzoor and Nefti, 2009). According to the published security guidance in cloud computing by Cloud Security Alliance (CSA) (CSA, 2011), there are two types of monitoring mode:

- Database Activity Monitoring (DAM)：Database Activity Monitor captures and records all Structured Query Language (SQL) activity in database in real time or near real time. The database monitoring server will generate alerts on policy violations.
- File Activity Monitoring (FAM)：FAM records how the customers access file and generate alerts on policy violations.

Until now, there are some solutions of new generation DAM which are based on kernel-level implementations and other intrusive approaches (Lombardi and Di Pietro, 2011; Shao et al., 2010). This means that adding a layer of security requires changes in architecture and relies on the virtualization technology. McAfee, the world's largest dedicated security technology company, has made an effective solution which can be easily embedded into the guest VM. This is the so-called McAfee Database Activity Monitoring (McAfee, 2012). In short, within the proposed infrastructure, the TTP, agent modules and improved sanitization procedure are adopted to assure the security of sensitive data.

PROPOSED MECHANISM

In order to achieve the data sanitization, the entire data life cycle must be monitored. In this way, the manager can record and control the detailed process of data usage and storage. Based on the above-mentioned McAfee Database Activity Monitoring, we further design a monitoring mechanism to handle the data sanitization problem as shown in Figure 1. In cloud environments, the customers, in general, deploy the needed applications, platforms or infrastructures on VMs. Therefore, we suggest that a monitoring agent should be embedded into every VM which hosts the application or database.

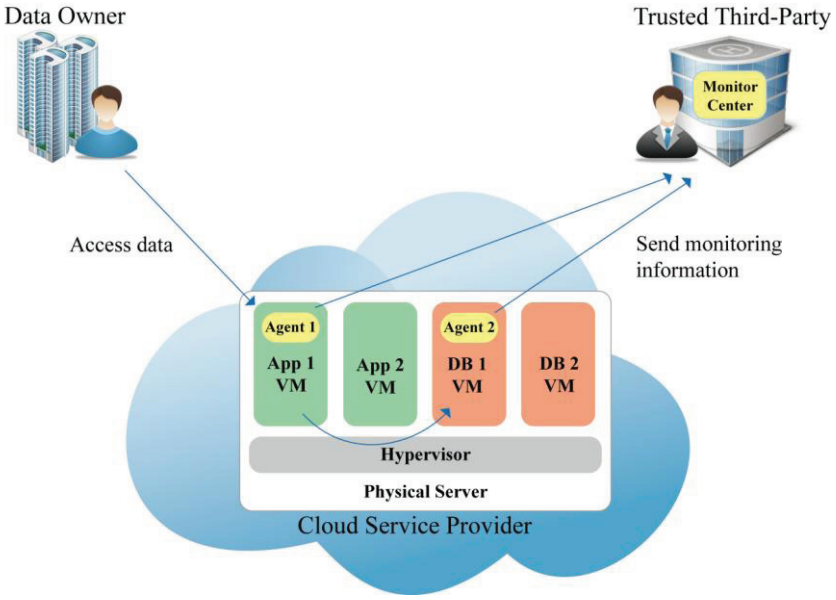


Fig. 1 Monitoring architecture

- Access function：while the data owner accesses data via applications on VM, agent 1 shall collect the log information and sent to the TTP.
- Process function：agent 1 shall also monitor communication between the applications and database.
- Store function：agent 2 shall monitor the database and have all activity reports sent to TTP.

FUTURE WORKS

Currently the design of monitoring mechanism in cloud environment is already finished but the detailed data sanitization procedure is still under construction. Furthermore, the security analysis and performance analysis should be conducted thereafter. The security analysis is going to include the man-in-the-middle attack, verifiability, brute-force attack, and spoofing and so on. We plan to implement the prototype of proposed mechanism by using Hadoop platform. As for the performance analysis, the speed of overwriting and the efficiency of monitoring center will be assessed. Finally, we will compare with McAfee Database Activity Monitoring about performance.

REFERENCES

1. CSA (2011), “Security guidance for critical areas of focus in cloud computing v3.0”, Cloud Security Alliance.
2. Kortchinsky, K. (2009), “CLOUDBURST: A VMware guest to host escape story”, Black Hat USA, Las. Vegas, USA, June 2009.
3. Lombardi, F., and Di Pietro, R. (2011), “Secure virtualization for cloud computing”, Journal of Network and Computer Applications, Vol. 34 No. 4, pp. 1113-1122.
4. Manzoor, U., and Nefti, S. (2009), “An agent based system for activity monitoring on network–ABSAMN”, Expert Systems with Applications, Vol. 36 No. 8, pp. 10987-10994.

5. McAfee (2012), "Database security in virtualization and cloud computing environments", McAfee.
6. Mell, P., and Grance, T. (2011), "The NIST definition of cloud computing", NIST Special Publication 800-145.
7. Ristenpart, T., Tromer, E., Shacham, H., and Savage, S. (2009), "Hey, you, get off of my cloud: exploring information leakage in third-party compute clouds", in the 16th ACM Conference on Computer and Communications Security Proceeding of the International Conference in Chicago, IL, USA.
8. Shao, J., Wei, H., Wang, Q., and Mei, H. (2010), "A runtime model based monitoring approach for cloud", presented at the 2010 IEEE 3rd International Conference on Cloud Computing.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

ELECTRONIC WORD-OF-MOUTH: THE MODERATING ROLES OF PRODUCT INVOLVEMENT AND BRAND IMAGE

Chinho Lin, Institute of Information Management, National Cheng Kung University, Taiwan,
linn@mail.ncku.edu.tw

Yi-Shuang Wu, National Cheng Kung University, Taiwan
pair0406@gmail.com

Jeng-Chung Victor Chen, National Cheng Kung University, Taiwan,
victor@mail.ncku.edu.tw

ABSTRACT

Purpose: *As an Internet-based version of word of mouth, electronic word-of-mouth (eWOM), the new information presented from the perspective of consumers who have purchased and used the product, have become a major informational source for consumers. The purpose of this paper aims to investigate the influence of eWOM on purchasing intention. Moreover, this study examines the moderating effect of product involvement and brand image in the relationship between the effects of electronic word of mouth and purchase intention.*

Design/ methodology/approach: *The target samples of this study are people who have ever searched for opinions or reviews through the Internet before buying the product. The survey is consisted of three parts covering the following issues, including eWOM searching experience, measurement items of each variable, as well as demographics and Internet using experience. A structural equation modeling (SEM) is used to assess the relationships of the research model.*

Findings: *Viewing online reviews or comments is helpful for consumers because it makes consumers feel more confident on purchase decision. The results indicate that eWOM quality, eWOM quantity and sender's expertise have positive effect on purchase intention. Most importantly, product involvement and brand image have moderating effect in the relationship between eWOM and purchase intention.*

Originality/ value: *This study provides new insights into the eWOM, which in turn affects customer purchase intention.*

Keywords: Electronic word-of-mouth (eWOM), Product involvement, Brand image, Purchase intention, Structural equation modeling (SEM)
Paper type: Research paper

INTRODUCTION

As a new marketing channel, the World Wide Web differs from traditional retail formats in many ways. Consumers shop online cannot touch or smell the products, as would be possible in traditional retail stores, so their purchase judgments must be based on the product information presented on the website. On-line sellers seek to overcome this limitation by giving consumers the opportunity to share product evaluations on online platform. This consumer-created information is helpful in making purchase decisions because it provides indirect experiences of products.

Word-of-mouth (WOM) is defined as "all informal communications directed at other consumers about the ownership, usage, or characteristics of particular goods and services or their sellers (Westbrook, 1987)." While WOM has been traditionally spread among acquaintances through personal "contagions," its value has also been recognized and used in practice. Pioneered by the seminal Bass (1969) paper, WOM is widely considered as a major driver of new product diffusion for non-adopters. Additionally, the concept of positive word of mouth has been largely used by marketing professionals as it can serve both the purpose of measuring the effectiveness of the marketing tools like advertising and also at the same time be used as a credible source for gaining information relating to the product (Li and Zhan, 2011).

The rapid development of the Internet with its enhanced communication capabilities has dramatically increased the scale and scope of word-of-mouth communication. As an Internet-based version of word of mouth, online reviews, the new information presented from the perspective of consumers who have purchased and used the product, have become a major informational source for consumers. Online reviews have very important implications for a wide range of management activities, such as brand building, customer acquisition and retention, product development, as well as quality assurance. Companies such as Amazon.com and Circuitcity.com, provide convenient access for the customers to read and write review for the products sold on their websites. Reichheld (2003) claimed that a customer's propensity to recommend a product to others – termed referral value - was the most important success measure in business today. Reichheld argued that referral value has a higher correlation to firm performance than such traditional measures as customer

satisfaction.

As an Internet-based version of word of mouth, eWOM has become a major informational source for consumers before they buy the products. Whereas many studies have examined the importance and roles of online product reviews on sales (e.g., Chevalier and Mayzlin 2006, Godes and Mayzlin 2004, Dellarocas, Awad and Zhang, 2004, Judith and Dina, 2006), few studies pay attentions on eWOM's influences on consumer purchase intention, and this reason motivates this study to conduct the research. Therefore, this study aims to investigate the influence of eWOM (including quality and quantity of eWOM as well as sender's expertise) on purchasing intention. Additionally, this study examines the moderating effect of product involvement and brand image on the relationship between the effects of electronic word of mouth and purchase intention.

THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

Electronic Word of Mouth (eWOM)

Historically, word of mouth is widely considered as a powerful influence in consumer marketplace, especially on consumers' information search and subsequent decision making (Brown & Reingen, 1987; Money, Gilly, & Graham, 1998; Silverman, 1997). With the rapid growth of the Internet, electronic communication has become a critical phenomenon. According to Buttle (1998), computer-mediated communication such as blogs, message boards, and emails can also be included in the definition. Following the notion, Hennig-Thurau et al. (2004) described electronic word of mouth as "any positive or negative statement made by potential, actual, or former customers about a product or company, which is made available to a multitude of people and institutions via the Internet (p. 39)". Comparing with WOM, Bickart and Schindler's (2001) showed that eWOM may have higher credibility, empathy and relevance to customers than marketer-created sources of information on the Web.

In this study, eWOM is viewed from three dimensions, including eWOM quality, eWOM quantity, as well as sender's expertise. Quality of eWOM refers to the persuasive strength of comments embedded in an informational message (Bhattacherjee, 2006). Consumer buying decision can be based on some criteria or requirement that meet their needs and to determined their willingness to buy it will be based on their perceived of quality of information they received (Cheung 2008). Therefore, it is important to determine consumer's perception of information quality as element for assessing their potential buying decision. In addition,

quantity of eWOM refers to total number of posted comments (Cheung and Thadani, 2010). The popularity of the product is determined by quantity of online comments because considered could represent the market performance of product (Chevalier and Mayzlin, 2003). Consumer also need reference to strengthened their confidence to reduce the feeling making mistake or risk while shopping, and online comment quantity represent the product popularity and importance. In other words, consumers may perceive that more reviews represent higher product popularity and importance (Lee, 2009). Furthermore, expertise is aptitude, required training and experience and is domain specific. On the other hand, expertise can be viewed as "authoritativeness," "competence," and "expertness" (Hung and Cheng 2006). It is considered that the expertise of sender when they made a comment in consumer review will attract user to adopt the information and make decision to purchase.

Purchase Intention

Purchase intention refers to consumer's intention to purchase a particular product or service. Purchase intention, was cited by Fishbein and Azjen (1975), as the single most accurate predictor of actual purchase behavior. Several studies have been conducted in this regard, and have found statistically significant relationships between purchase intention and actual purchase behaviors. It has been found that, particularly in the consumer durable goods category, purchase intention is a reliable measure of actual purchase behavior (Kalwani and Silk, 1982). Research conducted by Godes and Mayzlin (2009) tried to focus on the ways a firm should try to use the exogenous word of mouth to foster the sales. The research result showed that exogenous word of mouth accounts for the higher level of sales for the organizations.

Word of mouth could be one of the most believable form (Henricks, 1998) and affect consumer's choices of products in the WOM spread by other consumers (Brown & Reingen, 1987; Herr, Kardes, & Kim, 1991). Moreover, the Internet allows peoples' opinions can be more easily and quickly accessible to other consumers. Advices and product using experiences from online users become influential for their behavior (Thompson, 2003) and eWOM is regarded as a critical source for consumers making a buying decision. Some related studies have also indicated that eWOM messages are an important means whereby consumers can obtain information about product or service quality (Chevalier and Mayzlin, 2006). Moreover, this kind of message can effectively reduce the risk and uncertainty recognized by consumers when purchasing products or services, so that their purchase intention and decision making can be further influenced (Chatterjee, 2001).

eWOM quality is defined as the quality of a review's contents from the perspective of

information characteristics (relevance, understandability, sufficiency, and objectivity). Since previous buyers are anonymous on the Internet, people generally will not easily accept or believe a review posted on a Web site if it does not provide enough information (Ratchford, Talukdar, and Lee, 2001). Other things being equal, reviews that are more persuasive have a greater positive effect on consumers' purchasing intention. Besides, the number of on-line consumer WOM (eWOM quantity) of a product represents the product's popularity as the on-line word-of-mouth effect because it is related to the sales volume of the product (Chatterjee 2001; Chen and Xie 2004). It is likely to lead consumers to rationalize their purchasing decisions by telling themselves, "Many other people also bought the product." Additionally, consumers usually have belief in expert due to experts represent the individuals who have more professional knowledge (Alba & Hutchinson, 1987). Therefore, this study proposes that：

H1: The quality of electronic word-of-mouth positively affects consumers' purchasing intention.
H2: The quantity of electronic word-of-mouth positively affects consumers' purchasing intention.
H3: Sender's expertise positively affects consumers' purchasing intention.

Product Involvement

Product involvement, as defined by Zaichkowsky (1986), refers to "a person's perceived relevance of the object based on inherent needs, values, and interest." Involvement is associated with the motivation to process information, and prior knowledge (expertise) is associated with the ability to process information (Celsi, and Olson 1988; Petty and Cacioppo 1984). Issue-relevant arguments and product-relevant attributes were more influential under high-involvement conditions; while peripheral cues, such as the characteristics of information sources or number of arguments, were more influential under low-involvement conditions (Chaiken 1980; Petty and Cacioppo 1984; Petty et al. 1983). Therefore, this study proposes that：

H4a: Product involvement moderates the relationship between quality of eWOM and purchase intention.
H4b: Product involvement moderates the relationship between quantity of eWOM and purchase intention.
H4c: Product involvement moderates the relationship between sender's expertise and purchase intention.

Brand Image

Keller (1998) conceptualized brand image as a perception of consumers when they see a brand and reflected by brand associations in their mind. And these associations of brand image are multidimensional and contain the emotional dimension or the attitudes regarding the brand and the perceived quality dimension. From consumers' overall picture of their experiences, brand image is important because through this technique, brand image will create the consumer's cognitive, emotional, and behavioral responses as an outcome (Padgett and Allen, 1997). Moore (1981) argued that image is a mental estimate of a general degree of satisfaction from an organization's activities and performances. And through image investigation, organizers will know the attitudes from customers tend to their companies, indeed, how well customers understand and what they prefer of companies.

Park, Jaworski, and Maclnnis (1986) advanced that brand image is one strategic technique with the goal of helping the concept of a brand to be completed by means of an exercise in brand management. The objective of companies is to establish favorable and positive connection about the brand which the outcome in a positive image of the brand. The consumer may have more desire with one brand simply because this brand has the different image from other competitor's brands (Schiffman and Kanuk, 1994). Engel et al. (2001) indicated that consumers will make the decision based on the existing and external information. When there is the conflict between brand image and information content, consumer's decision will be hard to make. Therefore, this study proposes that：

H5a: Brand image moderates the relationship between quality of eWOM and purchase intention.

H5b: Brand image moderates the relationship between quantity of eWOM and purchase intention.

H5c: Brand image moderates the relationship between sender's expertise and purchase intention.

RESEARCH DESIGN AND METHODOLOGY

Research Assumption

Base on the literature review in chapter two, the research model of this study is shown in Figure 3-1.

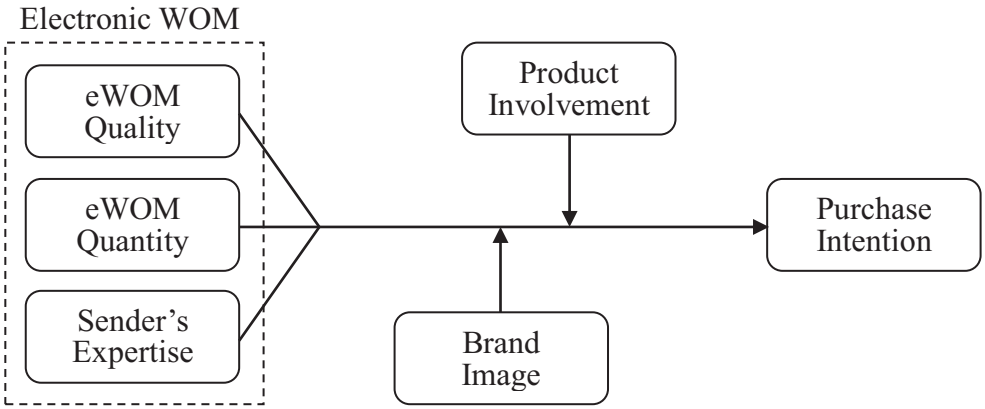


Figure 3-1 The Research Framework of This Study

After reviewing the literature in chapter two and basing on the research objectives and framework, the research hypotheses were proposed as shown in table 3-1:

Table 3-1 Research Hypotheses

Hypothesis	Content
H1	The quality of electronic word-of-mouth positively affects consumers' purchasing intention.
H2	The quantity of electronic word-of-mouth positively affects consumers' purchasing intention.
H3	Sender's expertise positively affects consumers' purchasing intention.
H4a	Product involvement moderates the relationship between quality of eWOM and purchase intention.
H4b	Product involvement moderates the relationship between quantity of eWOM and purchase intention.
H4c	Product involvement moderates the relationship between sender's expertise and purchase intention.

Table 3-1 Research Hypotheses (cont.)

Hypothesis	Content
H5a	Brand image moderates the relationship between quality of eWOM and purchase intention.
H5b	Brand image moderates the relationship between quantity of eWOM and purchase intention.
H5c	Brand image moderates the relationship between sender's expertise and purchase intention.

Research Design

To achieve the study objectives, a self-administered survey questionnaire was developed based on the findings of the literature review. The survey consisted of three parts covering the following issues: (1) eWOM searching experience, (2) measurement items of each variable, and (3) demographics and Internet using experience.

In the first section, respondents were asked to answer their eWOM searching experience, including the channel (ex. BBS, Forum, Blog…etc.) they used, the product they usually search for (ex. 3C product, food, cosmetics product…etc.), and the reasons they search comments via Internet. The second section is for the measurement items. Regarding the electronic word of mouth, to measure eWOM quality, initially 7 items were adapted from the studies of Park et al. (2007) and Bailey and Pearson (1983), however, 1 item was deleted because its factor loading is less than 0.7. Four items were adapted from Park and Lee (2008) as well as Do-Hyung and Band (2008) to measure eWOM quantity, in which, 1 item was deleted because of lower factor loading (<0.7). As for sender's expertise, 7 items were adapted from Gilly et al. (1998), but 2 item were deleted because the factor loading are less than 0.7. Besides, initially 9 items were adapted from Zaichkowsky (1986) 's research to measure product involvement, and 9 items were adapted from the study of Dodds et al. (1991) to measure brand image, however, 3 items of product involvement and 4 items of brand image were deleted because the factor loading are less than 0.7 Furthermore, in order to measure purchase intention, 5 items were adapted from the study of Baker and Churchill (1977). All the measurement questions of eWOM, product involvement, brand image and purchase intention were carried out by a seven-point Likert scale, ranging from "1=Extremely disagree" to "7= Extremely agree". In the last section of the questionnaire gathered respondents' demographic information, such as gender, age, education, monthly income, and

their Internet using experience.

The target samples of this study are the people who have ever searched for opinions or reviews through the Internet before buying the product. Online questionnaire sampling is the major way in this study by using the online survey website- mySurvey. Meanwhile, the address link of online questionnaire was posted in personal website such as facebook, and also spread by friends. In the end, 182 responses were received and valid. Data analysis involves descriptive statistics using SPSS 20 and structural equation modeling using AMOS 20 structural equation program. AMOS is designed to estimate and test structural equation models (SEMs). SEMs are statistical models of linear relationships among latent (unobserved) variables and manifest (observed) variables. Its purpose is estimating the coefficients in a set of structural equations. For this research AMOS is used to investigate the causal relationships, where the path coefficients are tested for significance and goodness-of-fit. The overall model fit measures were used to evaluate the fit of the structural model. In estimating the goodness-of-fit indices (GFI) for measurement and structural models, χ^2 (chi-square) test was used. In addition, the root mean square error of approximation (RMSEA) was used as an absolute fit index. The incremental fit index (IFI) nd the comparative fit index (CFI) were used as incremental fit indices. Standardized estimates were used in reporting the causal relationships between the exogenous and endogenous constructs.

DATA ANALYSIS AND RESULTS

54.6% of the respondents were male and 45.4% were female. The 21–30 age group occupied 72.8% of the total sample respectively. For the education level, 58.3% of respondents are with college/university degree and 37.6% of respondents are with master or doctoral degree. Regarding the experience of Internet usage, 75.5% of respondents said they have used Internet for more than 8 years. The majority of respondents use Internet everyday (82%). When people search for the product review or comment, the major platform that respondents use is the forum (41.6%) to search the 3C product (38.2%) and food (30.6%).

Measurement of Validity and Reliability

As shown in the Table 1, the result of CFA indicates that convergent validity represented by construct reliability (CR) and average variance extract (AVE) are greater than 0.7 and 0.5 respectively.

Table 4-1. CFA Outcome for the Measurement Model

	Factor Loading	CR Construct Reliability	Eigen-value
eWOM Quality			
The online review/comment is clear.	0.863	0.876	1.752
The online review/comment is understandable.	0.871		
The online review/comment is helpful.	0.860		
The online review/comment is credible.	0.752		
The online review/comment has sufficient reasons supporting the opinions.	0.782		
In general, the quality of each online review/comment is high.	0.755		
eWOM Quantity			
The number of online review/comment is large, inferring that the product is popular.	0.873	0. 853	1.746
The quantity of online review/comment information is great, inferring that the product has good sales.	0.846		
Highly ranking and recommendation, inferring that the product has good reputations.	0.768		
Sender's Expertise			
The persons who provided online reviews/comments, I think they are experienced.	0.882	0.850	1.684
The persons who provided online reviews/comments, I think they have abundant knowledge toward the product.	0.876		
The persons who provided online reviews/comments, I think they have the ability on judgment.	0.812		
This person provided some different ideas than other sources.	0.761		
This person mentioned some things I had not considered.	0.752		
Purchase Intention			

	Factor Loading	CR Construct Reliability	Eigen-value
After reading online review/comment, it makes me desire to buy the product.	0.884	0.869	1.728
I will consider buying the product after I read online review/comment.	0.879		
I intend to try the product/service discussed in the online review/comment.	0.872		
In the future, I intend to seek out the product/service discussed in the online review/comment.	0.860		
In the future, I intend to buy the product discussed in the online review/comment.	0.844		
Product Involvement			
When I am looking for the online reviews/comments, I think the product is important to me.	0.873	0.842	1.673
When I am looking for the online reviews/comments, I think the product is meaningful to me.	0.870		
When I am looking for the online reviews/comments, I think the product is useful to me.	0.867		
When I am looking for the online reviews/comments, I think the product is valuable to me.	0.849		
When I am looking for the online reviews/comments, I think the product is attracting to me.	0.765		
When I am looking for the online reviews/comments, I am interested in the product.	0.820		
Brand Image			
The brand is safe.	0.817	0.784	1.569
The brand is reliable.	0.824		
The brand has good quality.	0.808		

	Factor Loading	CR Construct Reliability	Eigen-value
The brand is interesting.	0.739		
The brand can make me feel happy.	0.746		

The Goodness of Fit Test for the Structure Model

The model was estimated using AMOS. Table 4-2 shows the result of goodness fitting indexes for the structure model and provides a reasonably good fit for the data ($\chi 2 = 367.891$, degrees of freedom (df) = 2.485, $p < 0.000$; comparative fit index (CFI) = 0.914; normed fit index (NFI) = 0.909; root mean square error of approximation (RMSEA) = 0.057). All of these fit indices are acceptable, suggesting that the overall structural model provides a good fit.

Table 4-2. The Goodness of Fit for Structure Model

Model goodness fitting	Preferred value	Value
CMIN/DF	< 3	2.835
GFI	> 0.9	0.902
AGFI	> 0.8	0.883
RMR	<0.05	0.036
RMSEA	< 0.08	0.057
NFI	[0,1] and approaches 1	0.909
RFI	[0,1] and approaches 1	0.902
IFI	[0,1] and approaches 1	0.914
CFI	[0,1] and approaches 1	0.914

Hypotheses Test

The result demonstrates that paths representing H_1, H_2, and H_3 are supported as shown in Table 4-3.

Table 4-3. The Result of Hypothesis Test

	Estimate weight	S.E.	C.R.	p-value
H1: eWOM Quality →Purchase Intention	0.452	0.051	8.626	***
H2:eWOM Quantity →Purchase Intention	0.436	0.045	7.947	***
H3: Sender's Expertise →Purchase Intention	0.385	0.047	5.563	**

****p-value <0.001, **p-value <0.05, *p-value <0.1;*

The Moderating Effect

As for moderating effect, Table 4-4 demonstrates the result of Hypothesis 4a, 4b, and 4c as well as Hypothesis 5a, 5b, and 5c. In conclusion, product involvement and brand image can moderate the effect the relationship of eWOM and purchase intention.

Table 4-4. The Moderating Effect of Product Involvement and Brand Image

Variables	Model 1	Model 2	Model 3
eWOM Quality	0. 508***	0.487***	0.442***
eWOM Quantity	0.427***	0.351**	0.406
Sender's Expertise	0.258	0.198	0.205
Product Involvement		0.283**	
eWOM Quality x Product Involvement		0.177**	
eWOM Quantity x Product Involvement		0.092	
Sender's Expertise x Product Involvement		0.049*	
Brand Image			0.278***
eWOM Quality x Brand Image			0.196**
eWOM Quantity x Brand Image			0.105*
Sender's Expertise x Brand Image			0.063*
R^2	0.537	0.298	0.362
ΔR^2 (Changed R^2)	0.526	0.288	0.335
F-value	29.361***	22.714***	18.683**
Durbin-Watson (D-W)	2.348	2.153	2.217

DISCUSSIONS AND CONCLUSIONS

Considerable previous research has studied the effects of offline WOM on consumer behavior. With the substantial growth in electronic word of mouth, there is a need for marketers to better understand how electronic word of mouth might influence consumer's purchase intention. The major objective of this study is to investigate the relationship among electronic word of mouth and purchase intention by adopting Structural Equation Model (SEM). This study also evaluates the moderating effect of product involvement and brand image on the relationship between electronic word of mouth and purchase intention. The research results indicate that, first of all, consumers who feel uncertainty toward the product tend to search for the online comments. Viewing online comments is helpful for consumers because it can make consumers feel more confident on purchase decision. Comments that are clear, logical and persuasive, with sufficient reasons based on specific facts about the product, have a strong positive effect on the purchase intention. Most importantly, this study finds a moderation effect of product involvement and brand image on the relationship between electronic word of mouth and purchase intention

This study makes several practical contributions. The major results emphasize the importance of properly managing online consumer reviews. Since online word of mouth function both as informants and recommenders, they can be used strategically as a communication channel. For example, online sellers can provide a review format that enables reviewers to post high-quality reviews focusing on the informant role of online consumer reviews (providing user-oriented information to improve consumers' understanding of a product). Furthermore, this research brings several new insights for corporations to use electronic word of mouth as part of their strategic marketing campaign in gaining new consumers and holding onto the ones they already have.

Mitchell (2001) stated that people to people communication is indeed more relevant than traditional marketing. Communication brings forth exchange of goods, ideas, opinions and other information. More importantly, communication is able to help people form relationships that include "ties of loyalty and feelings of obligation", as well developing supportive ties with other people. Peppers and Rogers (2000) proposed that knowledge can build relationships between a firm and its customers, and when a customer volunteers information, it is the firm's duty to act upon this information. While Selnes and Sallis (2003), identified relationship learning as a vital way to create differential advantage for the firm. Corporate blogs or online spaces can develop this awareness to their advantage, by providing factual information and encouraging consumer to consumer knowledge exchange, marketers would

be able to get real time feedback from their consumers, thus building customer loyalty and generating sales (Senecal and Nantel, 2004; Goldsmith and Horowitz, 2006). As Scoble and Israel (2006) said, electronic word of mouth as a marketing tool can also help leverage the competitive advantages of small businesses, enabling them to compete among the more established enterprises. Electronic word of mouth can significantly influence consumer behavior, so marketers should not ignore the proliferation of online consumer-to-consumer communication. In all of this, marketers need to remember that electronic word of mouth is consumer-generated and, in principle at least, marketers are on the sidelines. As Brown has pointed out (Brown et al. 2007), marketers need to be aware of the risks involved in attempting to influence electronic word of mouth.

REFERENCE

1. Alba, J. W., & Hutchinson, J. W. (1987). "Dimensions of consumer expertise." Journal of Consumer Research, Vol.13, pp.411-454.
2. Bagozzi, R. P. (1979). "Toward a formal theory of marketing exchanges, conceptual and theoretical developments in marketing." O.C. Ferell, S.W. Brown & C. W. Lamb Eds., Chicago: American Marketing Association, pp.431–447.
3. Bailey, J.E. & Pearson, S.W. (1983). "Development of a tool for measuring and analysing computer user satisfaction." Management Science, Vol.29 No.5, pp.530-545.
4. Baker, Michael J. & Gilbert A. Churchill, Jr. (1977). "The impact of physically attractive models on advertising evaluations." Journal of Marketing Research, Vol.14, pp.538-555.
5. Bass, F. M. (1969). "A new product growth model for consumer durables." Management Science, Vol.15 No.5, pp.215-227.
6. Bhattacherjee, A. a. S. (2006). "Influence process for information technology acceptance: an elaboration likelihood model." MIS Quarterly, Vol.30 No.4 pp.805-825.
7. Bickart, B., & Schindler, R. (2001). "Internet forums as influential sources of consumer information." Journal of Interactive Marketing, Vol.15 No.3 pp.31-40.
8. Bourdeau, J. Chebat & C. Couturier. (2002). "Internet consumer value of university students: E-mail-vs.-web users." Journal of Retailing and Consumer Services, Vol.9 pp.61-69.
9. Brown, J. J. & Reingen, P. (1987). "Social ties and word-of-mouth referral behavior." Journal of Consumer Research, Vol.14 pp.350-362.
10. Brown, J., Broderick, A. & Lee, N. (2007). "Word of mouth communication within online communities: Conceptualizing the online social network." Journal of Interactive Marketing, Vol.21 No.3 pp.2-20.

11. Buttle, F. A. (1998). "Word of mouth: Understanding and managing referral behavior." Journal of Strategic Marketing, Vol.6 No.3 pp.241-254.
12. Celsi, R.L., & Olson, J.C. (1988). "The role of involvement in attention and comprehension processes." Journal of Consumer Research, Vol.15 No.2 pp.210–224.
13. Chaiken, S. (1980). "Heuristic versus systematic information processing and the use of source versus message cues in persuasion." Journal of Personality and Social Psychology, Vol.39 No.5 pp.752–766.
14. Chatterjee, P. (2001). "Online reviews: Do consumers use them?" Advances in Consumer Research, Vol.28 pp.129-133.
15. Chen, Y., & Xie, J. (2004) "Online consumer review: A new element of marketing communications mix." Working Paper. University of Arizona.
16. Cheung, C. M. K. and Thadani, D. R. (2010). "The state of Elecronic Word-of-mouth Research: A literature Analysis." Proceedings of the Pacific Asia Conference on Information Systems, pp.1580-1587.
17. Cheung. E. a. (2008). "The impact of electronic word-of-mouth: The adoption of online opinions in online customer communities." Internet Research, Vol.18 No.3, pp.229-247.
18. Chevalier, J. & Mayzlin D. (2006). "The effect of word of mouth on sales: Online book reviews." Journal of Marketing Research, Vol.43, pp.345-354.
19. Chevalier, J. A. and Mayzlin, D. (2003). The effect of word of mouth on sales: Online book reviews. National Bureau of Economic Research Cambridge, Mass, USA.
20. Chevalier, J.A. and Mayzlin, D., (2006), "The effect of word of mouth on sales: online book reviews", Journal of Marketing Research, Vol. 43 No. 3, pp. 345–354.
21. Chiarelli, N. (2006). "The global rise of word of mouth." Brand Strategy, October, pp.42-43.
22. Dellarocas, C., Awad, N., & Zhang, X. (2004). "Exploring the value of online reviews to organizations: Implications for revenue forecasting and planning." In J.I. DeGross (ed.) Proceedings of the Twenty-Fifth International Conference on Information Systems. New York: ACM Press: 379-386.
23. Dodds, W. B., Monroe, K. B., & Grewal, D. (1991). Effects of price, brand, and store information on buyers' product evaluation. Journal of Marketing Research, Vol.28, pp.307-319.
24. Doh, S.M.S. & Hwang, J. (2009). "How consumers evaluate eWOM (Electronic Word-of-Mouth) messages." CyberPsychology & Behavior, Vol.12 No.2, pp.193-197.
25. Do-Hyung Park, S. K. and Band, W. (2008). "The effect of consumer knowledge on message processing of electronic word-of-mouth viaonline consumer review." Electronic Commerce Research and Applications, Vol.7, pp.399-341.
26. Eagly & Chaiken (1993). The Psychology of Attitudes. Fort Worth, TX: Harcourt Brace

Jovanovich.
27. Engel, J. R., Blackwell, R. D., & Miniard, P. W. (2001). Consumer behavior. Orlando Florida: Harcourt Inc.
28. Fishbein, M. & Ajzen, I. (1975). "Belief, attitude, intention and behavior: An introduction to theory and research." Reading, MA: Addison-Wesley.
29. Gardner, B. B. & Levy, S. J. (1995). The Product and the Brand. Harvard Business Review, 33, pp.33-39.
30. Gilly, M. C., Graham, J. L., Wolfinbarger, M. F., & Yale, L. J. (1998). "A dyadic study of interpersonal information search." Journal of Academy of Marketing Science, Vol.26 No.2, pp.83-100.
31. Godes, D. & Mayzlin, D. (2009). "Firm-created word-of-mouth communication: Evidence from a field test." Marketing Science, Vol.28 No.4, pp.721-739.
32. Godes, D., & Mayzlin, D. (2004). "Using online conversations to study word-of-mouth communication." Marketing Science, Vol.23 No.4, pp.545-560.
33. Gruen TW, Osmonbekov T, Czaplewski AJ. (2006). "eWOM: The impact of consumer-to-consumer online know-how exchange on customer value and loyalty." Journal of Business Research, Vol.59 No.4, pp.449-456.
34. Hennig-Thurau, T., Gwinner, K. P., Walsh, G., & Gremler, D. D. (2004). "Electronic word-of-mouth via consumer-opinion platforms: What motivates consumers to articulate themselves on the Internet?" Journal of Interactive Marketing, Vol.18 No.1, pp.38-52.
35. Henricks, M. 1998. "Spread the word." Entrepreneur, Vol.26 No.2 pp.120-125.
36. Herr, Paul M., Frank R. Kardes, & John Kim (1991). "Effects of word of mouth and product attribute information on persuasion: An accessibility-diagnosticity perspective." Journal of Consumer Research, Vol.17 (March) pp.454-462.
37. Huang, J. H. and Chen, Y. F. (2006). "Herding in online product choice." Psychology and Marketing, Vol.23 No.5 pp.413-428.
38. Judith, A. C. & Dina, M. (2006). "The effect of word of mouth on sales: Online book reviews." Journal of Marketing Research, Vol.43 No.3, pp.345-354.
39. Kalwani, M.U. & A.J. Silk (1982). "On the reliability and predictive validity of purchase intention measures." Marketing Science, Vol.1 No.3, pp.243-286.
40. Keller, K. L. (1998). Strategy Brand Management: Building, Measuring, and Managing Brand Equity, 2nd edition. New Jersey: Prentice Hall.
41. Kotler, P. (2003). Marketing Management (11 ed.). Upper Saddle River, NJ, Prentice Hall.
42. Laurent, G. and J. N. Kapferer (1985) "Measuring Consumer Involvement Profiles,"Journal of Marketing Research, Vol.22, pp.41-53.
43. Lee, M. & Youn, S. (2009). "Electronic word of mouth (eWOM): How eWOM platforms

influence consumer product judgement." International Journal of Advertising, Vol.28 No.3, pp.473-499.

44. Lee, S. H. (2009). "How do online reviews affect purchasing intention?" African Journal of Business Management, Vol.3 No.10 pp.576-581.
45. Li, J. & Zhan, L. (2011). "Online persuasion: How the written word drives WOM, evidence from consumer-generated product reviews." Journal of Advertising Research, Vol.51 No.1, pp.239- 257.
46. Money, R. B., Gilly, M. C., & Graham, J. L. (1998). "Explorations of national culture and word-of mouth referral behavior in the purchase of industrial services in the United States and Japan." Journal of Marketing, Vol.62 No.4, pp.76-87.
47. Moore, H. F. (1981). Publish relations: Principles, cases and problems, 8th edition. Richard D. Irwin, Inc.
48. Oliver, R. L. & DeSarbo, W. S. (1988). "Response determinants in satisfaction judgments." Journal of Consumer Research, Vol.14 No.4, pp.495-508.
49. Padgett, D. & Allen, D. (1997). "Communicating experiences: A narrative approach to creating service brand image." Journal of Advertising, Vol.26 No.4, pp.49-62.
50. Park, C. W., Jaworski, B. J. & Maclnnis, D. J. (1986). Strategic brand concept-image management. Journal of Marketing, Vol.50 No.4, pp.135-145.
51. Park, D.H., Lee, J., and Han I., (2008). "eWOM overload and its effect on consumer behavioral intention depending on consumer involvement", Electronic Commerce Research and Applications.
52. Petty, R.E., & Cacioppo, J.T. (1984). "The effects of involvement on response to argument quantity and quality: Central and peripheral routes to persuasion." Journal of Personality and Social Psychology, Vol.46 No.1 pp.69–81.
53. Petty, R.E.; Cacioppo, J.T.; & Schumann, D. (1983). "Central and peripheral routes to advertising effectiveness: The moderating role of involvement." Journal of Consumer Research, Vol.10 No.2 pp.135–146.
54. Ratchford, B.T., Talukdar, D., & Lee, M.-S. (2001). "A model of consumer choice of the Internet as an information source." International Journal of Electronic Commerce, Vol.5 No.3, pp.7–22.
55. Ratchford, B.T., Talukdar, D., & Lee, M.-S. (2001). "A model of consumer choice of the Internet as an information source." International Journal of Electronic Commerce, Vol.5 No.3, pp.7-22.
56. Reichheld, F. F. (2003) "The one number you need to grow." Harvard Business Review, pp.1-9.
57. Schiffman, L. & Kanuk, L. (1994). Consumer Behavior, 5th edition. New Jersey: Prentice-Hall.

58. Scoble, R. & Israel, S. (2006). Naked conversations: How blogs are changing the way businesses talk with customers. John Wiley & Sons.
59. Selnes, F. and Sallis, J. (2003). "Promoting relationship learning." Journal of Marketing, Vol.67 No.3 pp.80-96.
60. Senecal, S. & Nantel, J. (2004). "The influence of online product recommendations on consumers' online choices." Journal of Retailing, Vol.80, pp.159-169.
61. Silverman, G. (1997). "How to harness the awesome power of word of mouth." Direct Marketing, Vol.60 No.7 pp.32-37.
62. Söderlund, M. & Rosengren, S. (2007). "Receiving word-of-mouth from the service customer: An emotion-based effectiveness assessment." Journal of Retailing and Consumer Services, Vol.14 No.2, pp.123-136.
63. Spears, N. & Singh S. N. (2004). "Measuring attitude toward the brand and purchase intentions." Journal of Current Issues and Research in Advertising, Vol.26 No.2, pp.53-66.
64. Trusov, M., Bucklin, R.E. & Pauwels K. (2009). "Effects of word-of-mouth versus traditional marketing: Findings from an Internet social networking site." Journal of Marketing, Vol.73 No.5, pp.90–102.
65. Vilpponen, A., Winter, S., & Sundqvist, S. (2006). "Electronic word-of-mouth in online environments: Exploring referral network structure and adoption behavior." Journal of Interactive Advertising, Vol.6 No.2, pp.71-86.
66. Westbrook, R.A. (1987). "Product/consumption-based affective responses and post purchase processes." Journal of Marketing Research, Vol.24 No.3, pp.258-70.
67. Zaichkowsky, J. L. (1986) "Conceptualizing Involvement," Journal of Advertising, Vol.15, pp.4-14.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE INTERNET OF THINGS: THE REVOLUTION OF TOMORROW OR THE OVERRATED TECHNOLOGY OF TODAY?

Aelita Skaržauskienė, Mykolas Romeris University, Lithuania
aelita@mruni

Marius Kalinauskas, Mykolas Romeris University, Lithuania
m.kalinauskas@mruni

ABSTRACT

Purpose: *To analyze problematic aspects related with the practical approaches of Internet of Things (IoT).*
Design/methodology/approach: *The article discusses problematic issues related with the IoT from various angles. The debates concerning IoT and its possible application fields continue for more than ten years. While the technological framework is created there are many challenges in the field concerning technological, legal and social perspectives. In this article we analyze the application issues related with the IoT. The topic is examined by different authors from narrow views thus lacking the big picture of global technology potential. The objectives of this paper are to overview and analyze the holistic approach towards the application fields of IoT in order to highlight strengths and weaknesses which come with the technology.*
Theoretical findings: *The necessity for web-based services is increasing along with the technological gadgets which support them. Applying things, which are connected in networks, could revolutionize many industry and service sectors thus creating new service provisions and administration methods based on information technology. Practical cases show that the applicability potential for IoT is wide; however, standardization, legal regulation and usability problems approach while the IoT solutions are advancing technologically and its potential market share increases. These issues should be taken into consideration while seeking for better balance among different sectors where the impact of IoT will be most significant.*
Research limitations / implications *– There are few comprehensive studies and projects which emphasize on benefits of IoT. Despite that, the usage of the technology will have its negative effects. It is only the matter of time when next generation networks will create systems which may be too sluggish for effective maintenance or architectural changes. Moreover, the area for application of IoT is so wide that the threats are hard to identify. Because of that it is possible to review the topics only focusing on narrow, but most comprehensively analyzed spectrum of problematic issues.*
Practical implications *– Theoretical framework for future research in the field was developed.*

Keywords: internet of things, internet of services, future internet
Research type: conceptual paper

INTRODUCTION

It took less than twenty years for internet to become one of the most valuable information gathering channel and a gate for new business models all over the world. Not many understood the mass and significance of this technology at the beginning but it is now clear that internet is one of the most important inventions, which transformed the understanding about information, communication and data exchange. While the quality and speed of the internet based services is improving steady, the possible internet evolution questions arise. One of the most probable steps for the next generation internet based service is the Internet of Things (IoT). The main idea of the IoT is circling around a connected network or networks in which things and other sensor-based objects communicate with each other. The ability to integrate small, energetically efficient and cheap sensor based objects into clouds of networks would cause the new business and service models and would expand beyond the human-machine interaction approach which is most frequently used in internet-based environments. The grid of "smart" objects connected together is a conception which may be dated back to 1991 with Mark Weiser's idea of ubiquitous computing (Weiser, 1991). Later on he developed the idea and predicted that the IoT objects will communicate without direct human interaction and will use the specific protocols and communication channels. The usage practices of IoT are not widespread at the moment, but the advances in wireless networking technology, price drop and further standardization of communication protocols is facilitating the process. However, the enthusiasm related with the possibilities of IoT is more based on future predictions then an actual spread at the moment. According to Thomson Reuters (2012): "Rogers Communications Inc , Canada's largest wireless company, says the "Internet of things" - fridges that write shopping lists and smoke alarms that send text messages - will be a C$400 million ($384 million) market in Canada by 2015 and that it wants a significant share". It seems like the IoT is at the doorstep and the major players in the market are trying to keep pace with one of the most promising technologies. On the one hand starting the competition in the newly established business branch enables the company to quickly react to emerging changes and to keep up with the technological base, on the other hand there are few main issues related with the development of IoT technology that should be seriously reconsidered before stepping into this area.

The firs problematic issue is related with the core element of every technology that is made – the user. The final target of and the determinant factor of any innovations is the user who is able to operate and willing to pay for the technology. The rational arguments about life facilitating features and wide opportunities of IoT may be not heard by the end-user if he would not understand the potential and possible benefits from the technology. The user experience and engagement elements are the key components for the success of IoT.

The second issue is the overall cost of the technology. And it is not just the price of the sensors, but also and infrastructure or business solutions as a whole. The internet - main framework for the sensor based objects together the Radio-Frequency Identification (RFID) microchips enable the IoT implementation. But the lack of standardization agreements is stopping the development while the legal and technical questions, related to data gathering and privacy protection arise. The sensor grid needs to reflect physical world and create a cheap and efficient information channel which could be easily accessed with certain type of controllers. The user interface network control application as well as the price and efficiency solutions will determine how easily IoT will find a way to homes and offices.

The last problematic issue comes from legal and ethical field and relates with the data protection and privacy control questions. It is clear that quantities of data which are processed by sensor based objects are massive. The potential value for this type of information is undeniable and is closely related with the most popular application fields for the IoT. RFID – the most popular technological realization of IoT – makes it possible to harvest a wide array of new data types, enabling data mining to predict consumer behavior and monitor other aspects of the physical environment (Winter, 2012). The data about consumer actions may be used by business structures for various purposes and in some cases the final user may not feel pleased if his heart performance data would go to health insurance office which may modify the contract conditions according to the newly obtained information. Preparation of clear privacy policies should be one of the main concerns while examining the issue.

In this article authors discuss and analyze these topics and try to answer the question: "is the IoT the revolutionary technology of tomorrow or is it the overrated technology of today?" The field of IoT is examined by many authors from even more different perspectives. However, the wide and globally usable network of things is still more a conception than the reality. Countries, even regions are competing in this area, because the success of applying the IoT may result an economic wellbeing for those who will be the first and most efficient in the field. Knowing the strengths and weaknesses of the technology opens the ways for solutions and innovations which will be definitely needed in the forthcoming age of IoT.

Internet of things – from the concept to the practice

The term "internet of things" was introduced by MIT Auto-ID Center, which later evolved into organization named EPCglobal. Radio-frequency identification (RFID) chips are used as the backbone of the IoT because of its ability to track a large number of uniquely identifiable objects with the use of Electronic Product Codes (EPC) (Aggarwal, Ashish, Sheth, 2013). Using unique addressing schemes, objects bearing RFID tags are able to interact and cooperate with other objects or detect alterations in their surroundings. RFID is the technological solution of how smart cooperative environment may be organized at the current technological advancement level. The possibilities concerning IoT are even broader. Internet of Services (IoS), 3D Internet, Internet of Content, are only few names of the technologies, which should be considered as a linked parts of the future internet (Haller, Karnouskos, Schroth, 2009). The IoS describes an infrastructure that uses the Internet as a medium for offering and selling services (Cardos, Voigt, Winkler, 2009). Service-oriented Architectures (SOA) and Web services will mainly serve as technological solutions that enable enterprise functionality to be made available to users as shared and re-usable services on a network (Curbera, M. Duftler, R. Khalaf, et al, 2002). With the help of the IoT, the IoS gains more significance and possible solutions for personalization and customization of a service. But IoS represents only one of the layers supported by IoT. These areas overlap, and it is hard distinct them by certain parameters. According to Information Society Technologies Advisory Group (2008), over the last decade, the service sector has become the biggest and fastest-growing business sector in the world and employs most people worldwide. The additional application of ICT solutions may help to expand this area even more, and with the help of IoT the next – generation services become possible, thus giving the boost for IoS. Moreover, if the IoT technology will succeed and find its way towards business and personal use, the snowball effect may occur in related industry sectors. However, it is not an easy task, because technological and social development (need for technology) was not fast (or smooth)

enough during last 20 years. Although the idea of cooperative objects may seem tempting, there are still some unfulfilled fields compared to the early vision of ubiquitous computing. Back in 1991, Weiser predicted, that "ubiquitous computing will enable nothing fundamentally new, but by making everything faster and easier to do, with less strain and mental gymnastics, it will transform what is apparently possible". In later publication Weiser (1993) states: "the challenge is to create a new kind of relationship of people to computers, one in which the computer would have to take the lead in becoming vastly better at getting out of the way so people could just go about their lives". The main idea was to minimize the necessity of human - computer interaction in daily activities by ensuring the smooth and constant data flow from sensor based devices to the processing and control units. All of these activities should have been invisible to human eye thus creating a "calm integrated world". Weiser believed, that over next 20 years "ubiquitous computing will gradually emerge as the dominant mode of computer access". According to the early predictions, at the moment we should be surrounded by smart things which would exchange data among each other, with only small pieces of information visible to humans through user interface modules. So why do we not share calm environments after more than 20 years of progress? First of all, not all scientists agree with the idea of cooperative surroundings which relieves human beings from their mental and physical stress. Rogers (2006) claim that ubiquitous computing (ubicomp) technologies should be viewed as a key to enhanced learning, and contribute to the development of human intellect through creativity stimulation and better decision making. While Gaver (2006) sees object interaction as an environment for exploration and curiosity exercise by applying principles of gamification.

The real world structures and systems may seem al lot more complicated then the computerized model and it is hardly possible to represent the full scale of the environmental processes. At some sense the Weiser's vision is implemented in nowadays world. Smart houses, RFID tags in the product lines, environment aware cars, robots and other machinery show that technologically it is possible to implement the vision. However, Cáceres and Friday (2012) note that "there are nascent building blocks of the ubicomp visions that hint at the more tractable problems and help us identify the many challenges that stubbornly remain". Authors emphasize on world complexity problems, data transmission and security issues, technical aspects of ubiquitous computing. Despite all of these concerns the popularity of cloud computing and price decrease of sensory devices makes IoT one of the most perspective technologies of near future. Its influence will possibly be visible starting from international stage and ending with separate business sectors or individuals (figure 1).

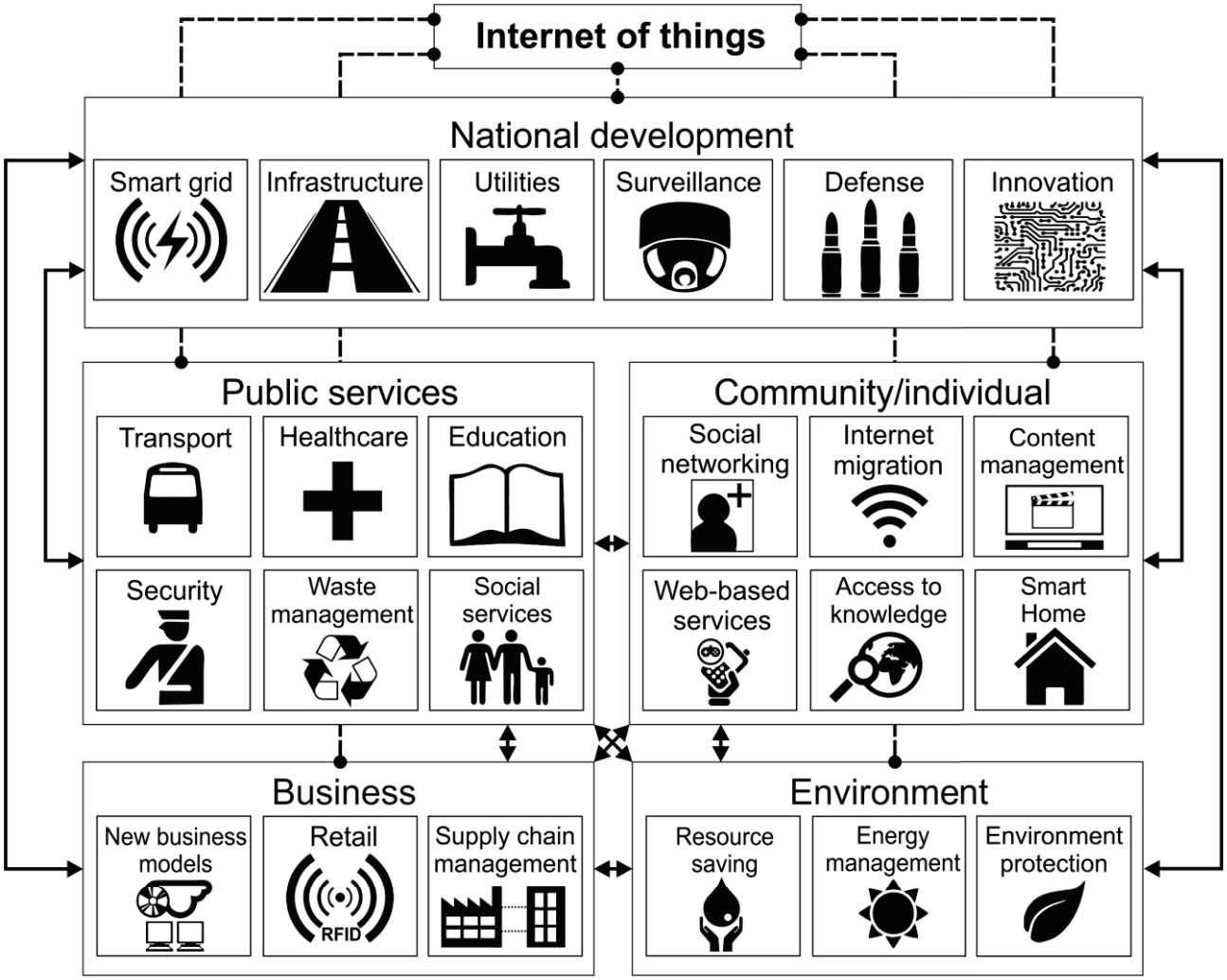


Figure 1. The impact of IoT to national development and related sectors

Looking from national perspective, the IoT may influence the infrastructure development directions. The coverage, speed and quality of telecommunication infrastructure are crucial for the IoT. By supporting or investing into ICT sector, countries may boost the other related industries or increase the living standards of individual households. The IoT technology may help optimizing resource usage, improve surveillance and defense systems and open new possibilities for innovation in associated fields. Grimes, Ren and Stevens (2009) note that better internet infrastructure has the positive impact towards the productivity of the firm. West (2010) supports the idea by concluding that: “high-speed broadband facilitates the adoption of remote wireless health monitors, GIS mapping, social media, distance learning, smart energy grids, file-sharing, and video conferencing”. The investment to the internet infrastructure and communication sector allows faster and smoother flow of information. The counties are competing on statistical numbers in the area of internet penetration, broadband connection rate, user count who works on the internet on daily bases and ect. This trend will be more significant when IoT will gain its momentum. While the internet penetration rates mostly affect people who are directly using the technology, the IoT may have an influence in a much broader scale, where the end users may be not aware of its presence. The European Commission is decided to implement its IoT policy for supporting an economic revival and

providing better life to its citizens, and it financed several IoT research projects as part of the 7th Framework Programme on European Research (CERP IoT, 2010). While going deeper into subject, scientists reveal the weak spots of the IoT conception. On the April 12th of 2012 European commission issued a press release named "Digital Agenda: Commission consults on rules for wirelessly connected devices - the Internet of Things". The Commission is seeking to get the opinions from interested parties on "privacy, safety and security, security of critical IoT supported infrastructure, ethics, interoperability, governance and standards" in the context of IoT (ibid). On the summer of 2013 Commission is planning to present the recommendation of IoT in which problematic questions will be examined more directly. Until then it is clear that the legal, ethical and social issues are none of the less important than the technological barriers and that the countermeasures against the negative effects of IoT should be considered seriously. At the end, the idea of "calm integrated world" seems reachable and possible in nearly future. The problem is, that current evolution of the technologies is not fast and smooth enough in order to create unified network (or networks) of "smart" things, which would revolutionize the way people live. It may take a lot more time to fully develop the IoT than Weiser predicted, because technological nuances reflect only one side of the deal, and the flipside may be not as appealing for the end users, together with its challenges and transformations which may be not too desirable at the moment.

The technological background for Internet of Things

Wireless technologies allow fast and quality information exchange and one of the first inventions which enabled this type of communication was the radio. Radio has been along with us for some time and the reduction of its price, energy consumption and size created new application opportunities in the area of IoT. RFID technology is a major breakthrough in the embedded communication paradigm which enables design of microchips for wireless data communication (Gubbi, Buyya, Marusic, Palaniswamia, 2012). The IoT is partly inspired by the success of RFID technology. RFID tag is a "smart" device equipped with an electronic chip and an antenna. RFID reader interacts with the tag and sends a signal to someone for further elaboration. RFID-enabled system will interpret the data and take actions according to situation. Radio Science and related Technology, represented by tag, makes the physical object an energy consumer, because RFID technology uses energy alimented active tags, or some energy is applied to the passive tags in order to ask them to activate the sending of data (Simonov, Zich, Mazzitelli, 2008). These microchips are widely used in retail businesses, supply and manufacturing chains, animal tracking or logistics. Embedded intelligence can further enhance the power of the IoT by devolving information and knowledge processing capabilities to the edges of the network (ibid). In the near future the application domains may expand towards healthcare, environment mapping or automotive solutions. However, there are few issues related with the application of RFID. First of all, the RFID device must have a unique identification method, which would allow distinguishing it from the millions of other objects. The EPC network may serve the purpose, but it is not the only standard. In Japan, the unicode is gaining popularity, and other groups propose to use IPv6 addresses for this purpose, there are also specific devices which are not mapped to EPC (Haller, et al, 2009). According to Vermesan, Friess, Guillemin, Gusmeroli, ... Doody, (2011) the open standards are key enablers for the success of wireless communication technologies. Without global recognized standards the expansion of RFID and IoT solutions cannot reach a global scale.

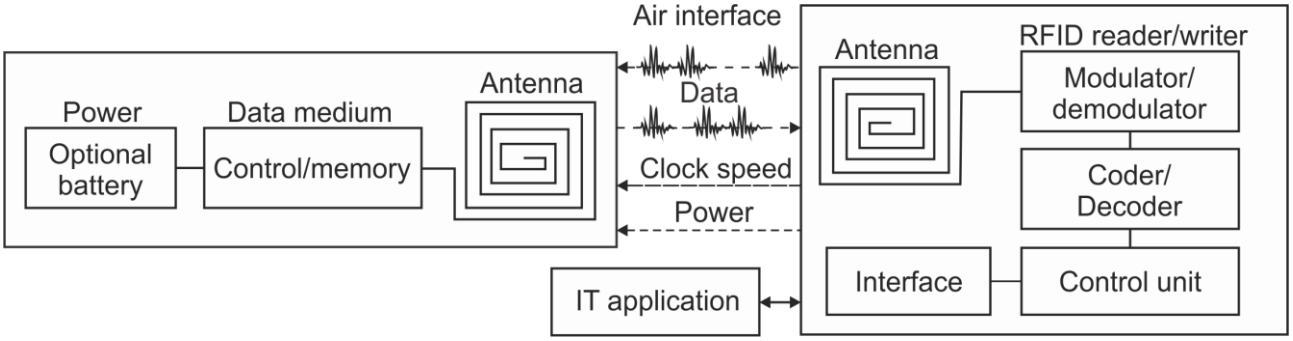


Figure 2. The working principle of RFID

This problem is common to all wide-used technological innovation and is real challenge for industrial and government bodies. Standardization has been sluggish, impacting large-scale commercial deployment of related services. Fortunately, companies are beginning to prioritize standardization (Zhihao, Yongfeng 2010). The EU is trying to move towards in order to apply IoT standards that cover multiple layers including technology, operation, and services. Standardization could reduce the costs of the technology and ensure availability to consumers which are one of the key elements in the field.

RFID standardization may be considered as a case of a good practice and as success, mostly thanks to the efforts of former Auto-ID center (now EPC Global), however, applying standards to the industry of robotics or nanotechnology is a complicated matter (ITU Internet Reports 2005).

RFID still stands at the forefront of the technologies driving the vision. This is a consequence of the RFID maturity, low cost, and strong support from the business community. However, they state that a wide portfolio of device, network, and service technologies will eventually build up the IoT. Near Field Communications (NFC) and Wireless Sensor and Actuator Networks (WSAN) together with RFID are recognized as the components which will link physical and virtual worlds (Atzori, et al., 2010). The EU sees RFID as one of the main technologies which better empower the calm digital environments, compared to the bar codes or magnetic tapes. In the EU vision, the concept of Digital Territory is an ambient layer of connectivity over Europe in order to deliver real-time services to citizens and RFID is seen as the glue to this wireless spectrum (Kranenburg, 2007). However the usage of the tags has its flaws and these negative aspects are mainly related with the legal and ethical issues concerning the data storage and usage. The sensor devices generate a large amount of information which must be transmitted, processed and reacted to. The environment generates data all the time and it is practically impossible to track the entire spectrum. The algorithms which support the data collection and processing should be “intelligent” enough in order to make sense from the data. State-of-the-art non-linear, temporal machine learning methods based on evolutionary algorithms, genetic algorithms, neural networks, and other artificial intelligence techniques are necessary to achieve automated decision making (Gubbi, et al., 2012) in the areas like automation, environmental control or waste disposal. The other challenging issue is related with the origin and usage of the data. This is the area where legal, ethical and technological nuances come into actions and different regulation rules in separate regions may affect the IoT’s positions in future market.

Privacy and data protection concerns

In the EU policy framework for RFID (2007) it is stated that application of RFID must be socially and politically acceptable, ethically admissible and legally allowable. RFID will only be able to deliver its numerous economic and societal benefits if effective guarantees are in place on data protection, privacy and the associated ethical dimensions that lie at the heart of the debate on the public acceptance of RFID. It is also noted that databases in which private data are stored should comply with neutrality and neutrality requirements. The report, "Internet of Things – an action plan for Europe" (2009), proposes 14 action points, including work on the policy governance of RFID, continuous monitoring of the privacy and data security issues arising, action over the recycling of the potentially vast number of smart chips and cards, and pan-European standards work. The right to silence a RFID chip may sound the most controversial. It gives the additional responsibilities to the industry, but the idea itself aims to limit the approach towards data to the third parties. This enables the better control of information stream and may raise the trust in the IoT sector. The question is especially important when speaking about sensitive personal data. Healthcare sector shows one of the biggest potentials for the IoT, however it is also one of the risky ones from the personal data protection perspective. It is possible to implant a microchip which would track the vital body parameters. On the one hand, this type of information is useful to the medical personnel and for the data subject. On the other hand, the leakage of the data to the third parties may result a conflicting situations. For example, health insurance companies could manipulate the terms and conditions in the health insurance contracts, advertisers may try to sell the medicine or other products to the people, who have problems with their health. According to Directive 95/46/EC of the European Parliament and of the Council, data associated with human health are considered as sensitive. It means that usage of technologies create many more legal and ethical questions which need to be answered. In the International Telecommunication Union report for the IoT (2005) it is stated that protecting privacy must not be limited to technical solutions, but encompass regulatory, market-based and socio-ethical considerations. Unless there are concerted efforts involving all government, civil society and private sector players to protect these values, the development of the IoT will be hampered if not prevented. Winters (2012) highlighted six main conflicts with novel practices related to the internet of things. But the most significant ones are related to location data, health data and identity data. Some applications used in smartphones track the location coordinates of the phone. The "smart" object may as well have this functionality and if the IoT grid has a wide coverage it is possible to track a person and his actions. The data may be used in marketing purposes or for illegal surveillance. So the ability to "hide" one's movement or activities should be available in these types of devices, because the tracking object may not always want to reveal its location to the third parties. The second issue is related with the health data problems, which were discussed earlier in the paper. Thirdly, the identity data (including biometric information) helps to determine who the person is, what he does and how he behaves. This type of information varies from sensitive to insignificant, however, the ability to collect identity dada at significantly low cost allow businesses to perform faster and more precise business intelligence actions. The end user does not necessary want to be recognized for his habits or behavior and the privacy policies legal regulation updates solve problem only partially. It is expected that attacks on privacy will become more popular with the growth of the IoT, since an increasing number of personal items will be reachable for queries and intrusions (Radomirović, 2010). So the cyber criminal activities may also appear more often. The privacy protection issues cannot be solved that all interested parties would be happy. The

stricter the regulation model is, the harder financial and management burden lays on the shoulders of the business. While on the opposite, business structure gain tons of valuable data, but customers are annoyed by target marketing complains or personalized advertisements. Moreover, the criminal elements may have a better access to information due to the IoT networks, so there is no simple solution to this issue. It is clear that the regions which try to regulate the IoT field in the context of privacy and data protection are a bit late, because the technology evolves a lot faster than the social norms. The win-win situation is hardly possible when the privacy issues and the development of IoT collide. The most likely regulatory mechanism will sacrifice something from the both sides, but while it's done on the national or regional level, the results may be unsatisfactory in the global scale.

Challenges and opportunities related to business and end-users

While there are many optimistic predictions towards implementing IoT, technical, social, legal and ethical questions are considered a challenging issue. Business, individuals and society are the main pillars on which IoT is based upon. Business is looking for the new opportunities in order to improve productivity and gain competitive advantage. The ICT sector plays an important role in the field and IoT, as one of the most intriguing technologies which may help reducing operation cost and improve resource management. Secondly, business companies are trying to sell more of their products according to customers' needs, expectations and wishes. Environment aware object may become the trending technology of the near future if leading ICT companies will decide to use it as a marketing tool in the fight for customers' pockets. Back in 2005 few would have thought that the phone with a touch screen and a price of a computer will be number one on the wish list. The same situation is with other "smart" devices. Seven years ago nobody cared about a smartphones, because there were no such things on the market, at least in a larger scale. Apple was not the first company which entered the smartphone industry, yet with a refreshing design and many innovations, Apple's iPhone quickly made inroads in the market (Lin, Ye, 2009). Wise marketing moves made by Apple created an army of loyal users who were attracted to something that was not even present a few years ago. The same scenario fits to the tablets. Figure 3 shows Google search trends from 2007 till 2013. The search phrases like "smartphone" or "tablet" compared to each other show an increase of query activity on Google search engine starting from 2010, while on 2007 it was rather low. The comparison of "smartphone" and "Internet of things" phrases show that the second query phrase is almost nonexistent. And it's not because the technology seems too futuristic or not interesting to the masses. The reason for these results comes from the fact, that IoT is more of a conception than a widely accepted phenomenon. Secondly, ICT companies do not push the IoT as a marketing brand.

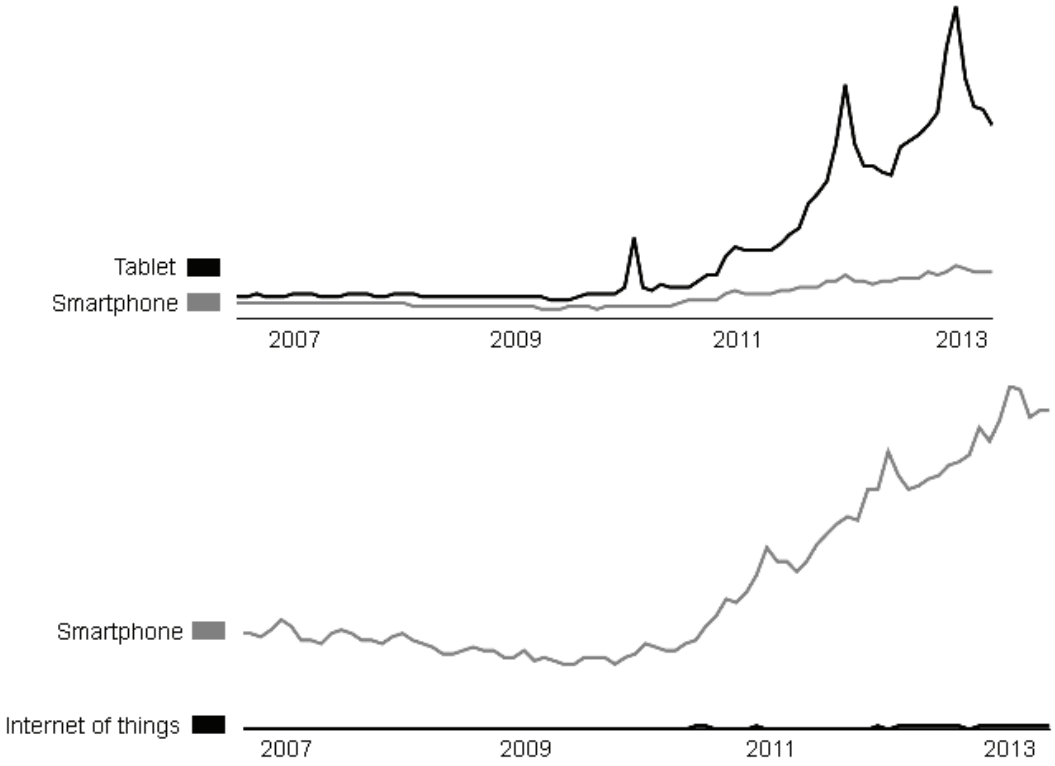


Figure 3. Google search trends since 2007. Keywords: tablet, smartphone, internet of things.

However, the comparison of more related terms like "internet of things, web of objects or ubiquitous computing" shows that the interest towards IoT is growing. It is obvious that Google search keywords related with the IoT cannot compete with popular names of "smart" gadgets. But the Figure 4 show that in some sense, the search trends reflect the social acceptability of the IoT technology as consumers look for more data about various topics of interest (Gubbi, et al., 2012). In order to apply the technology in the larger scale it is necessary that big players of the ICT market would convince the buyers that they are in need of intelligent environments together with the IoT.

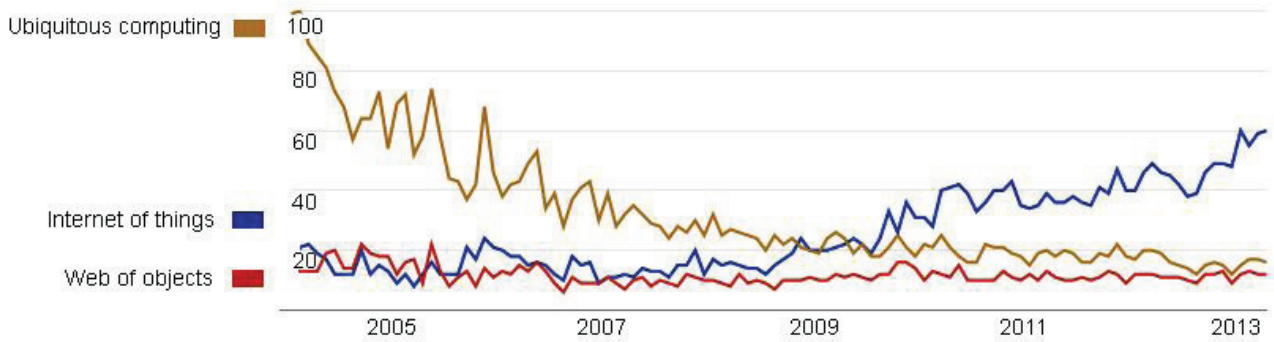


Figure 4. Google search trends since 2005. Keywords: ubiquitous Computing, internet of things, web of objects.

But convincing is only one part of the deal. Business subjects can create a market for the new product if the time is right and the offer is good. The hardest part is to keep the clients interested into product. Firstly, the smartphones and tablets own an entire set of digital products and solutions which makes them an attractive choice, plus they have a well-polished purpose and business model behind them. In the case of IoT all of these elements are lacking. Secondly, the IoT technology is less visible to the naked eye and the changes which it brings may be not so obvious for the end user. It seems like the IoT success is more dependant from business needs and expectations rather than regular user. According to Haller et al (2009), due to the rapid advances in the embedded systems domain, the manufacturing domain is undergoing significant changes as ubiquitous computing is applied to the shop floor. An entirely new dynamic network of cooperating devices can be created which effectively shows that the IoT can reshape the manufacturing domain". Moreover, the tracking of objects in the supply chain during the manufacturing process allows ensuring smoother operations. Real-time information processing technology based on RFID and near field communication (NFC) can realize real-time monitoring of almost every link of the supply chain (Atzori, Iera, Morabito, 2010). So the segment which will gain most out of IoT is the business organizations.

Business sector will be the most important piece on the board when speaking about application of IoT technology. However, at the moment the end-users are not too interested in the topic. European Union is trying to introduce the positive effects and potential areas of interest while publishing the roadmaps, communication plans and press releases (IoT – Strategic Research Roadmap, 2009), but none of these measures will give a significant effect unless the business structures will create new products and services, based on IoT technology. Moreover, these inventions must be presented in the appropriate light and create a real additional value to the end-user or society.

DISCUSSION AND CONCLUSIONS

The IoT is a technology which has truly great potential in improving business productivity, the well-being of individuals or the development of the state. While the first insights, concerning the creation of "calm integrated world" were rather optimistic, it is clear that advantages of the IoT do not come without a price. The technological background is there and governmental policies support the development of "smart" networks. The cost of the IoT infrastructure now seems acceptable, but technological penetration is relatively low. There are some problematic aspects down in the technological field, like the lack of standardization, data transmission, processing and management, middleware problems and system security issues. The next level questions are related with the privacy and data protection concerns. When the sensory objects collect such huge amount of data, or these data have an especial value, are sensitive or may be tampered by the criminal elements – it becomes a really hard equation for the state officials and privacy policy makers to put a balance between the technological progress and the fundamental human rights. But at the final end is the created value for the business subjects and the end-users. Though the optimism around the IoT is not lacking, the masses of the regular users do not seem too interested in the near future technology. Their attention is attracted by the big ICT market players advertising campaigns of other "smart" devices, which are more visible, sensible and understandable. The companies of ICT market have a strongest positions and responsibilities in the field of IoT. Firstly, they get the biggest additional value from the improved supply chain management,

logistic process optimization or object tracking. Secondly, they control the assets which could convince the end-user to accept the innovations related to the IoT. The price, business models and support products or services should also be the priority. So, is the IoT the revolution of tomorrow or the overrated technology of today? The answer lies somewhere in-between these statements. It is hardly possible that many interconnected sectors would apply the IoT in the nearest future. Sometimes development of technology comes chaotic and sometimes the little boost may break the dam, but in this case the nudge should be global and all of the interested parties should be prepared for the emerging changes. Is the technology overrated? No, it is not. But the application fields are so broad and the experience in the IoT is so fragmented, that the utopian scenario of "calm integrated world" will have to wait, maybe, not for too long. So the research on problems and challenges in technological, legal and social areas should be emphasized in order to better prepare for the upcoming era of IoT.

LITERATURE

1. Aggarwal, C., Ashish, N., Sheth, A., (2013). The internet of things: a survey from the data-centric perspective. Managing and Mining Sensor Data, pp 383-428
2. Atzori Luigi, Iera Antonio, Morabito Giacomo (2010). The Internet of Things: A survey. Computer networks
3. CERP-IoT cluster (2010). Internet of Things Strategic Research Roadmap'.Vision and Challengesfor Realising the Internet of Things.
4. Communication from the Commission to the European Parliament, the Council, the European Economic and Eocial Eommittee and the Eommittee of the Eegions (2007). Radio Frequency Identification (RFID) in Europe. Brussels, 15.3.2007 COM(2007) 96 final.
5. Communication from the Commission to the European Parliament, the Council, the European Economic and Eocial Eommittee and the Eommittee of the Eegions (2009). Internet of Things — An action plan for Europe. Brussels, 18.6.2009 COM(2009) 278 final.
6. Curbera F., Duftler M., Khalaf R., et al. (2002). "Unraveling the Web services Web: An introduction to SOAP, WSDL and UDDI", IEEE Internet Computing, 6(2), IEEE Computer Society, Los Alamitos, 2002, pp. 86-93.
7. Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data. Official Journal L 281 , 23/11/1995 P. 0031 – 005.
8. European Commission - Information Society and Media DG (2009). Internet of Things – Strategic Research Roadmap.
9. European Commission – Press relelease, (2012). Digital Agenda: Commission consults on rules for wirelessly connected devices - the "Internet of Things".
10. European Union 2010, Vision and Challenges for Realising the Internet of Things.
11. Gaver, William, (2006). The video window: my life with a ludic system. Personal and Ubiquitous Computing, 10(2-3):60–65.
12. Grimes, A., Ren, C., Stevens, P., (2009). The Need for Speed: Impacts of Internet Connectivity on Firm Productivity, Motu Working Paper 09-15.
13. Gubbi, J., Buyya, R., Marusic, R., Palaniswami M., (2012). Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions.Technical Report CLOUDS-TR-2012-2, Cloud Computing and Distributed Systems Laboratory, The University of Melbourne, June 29, 2012

14. Haller Stephan, Karnouskos Stamatis, Schroth Christoph, (2009) The Internet of Things in an Enterprise Context. Volume: 5468, Issue: 1, Publisher: Springer, Pages: 14-28
15. Information Society Technologies Advisory Group (2008). Working Group on Web-based Service Industry Version 12, 28th February 2008
16. ISTAG, Working Group, 2008. Future Internet Infrastructure, Version 8, 23 January 2008.
17. ITU Internet Reports (2005). The Internet of Things executive summary.
18. Lin Feida, Weiguo Ye (2009) Operating System Battle in the Ecosystem of Smartphone Industry.Information Engineering and Electronic Commerce, 2009. IEEC '09. International Symposium.
19. R. Caceres, A. Friday, (2012). Ubicomp Systems at 20: Progress, Opportunities, and Challenges, IEEE Pervas Comput. 11, pp 14–21.
20. Radomirović Saša (2010). Towards a Model for Security and Privacy in the Internet of Things. In 1st International Workshop on the Security of the Internet of Things, Tokyo, Japan.
21. Rob van Kranenburg (2007), The Internet of Things. A critique of ambient technology and the all-seeing network of RFID, Network Notebooks 02, Institute of Network Cultures, Amsterdam, ISBN: 978-90-78146-06-3.
22. Rogers, Yvonne (2006). Moving on from weiser's vision of calm computing: Engaging ubicomp experiences. In UbiComp 2006: Ubiquitous Computing, volume 4206, pages 404–421.
23. Simonov Mikhail, Zich Riccardo, Mazzitelli Flavia (2008). RFID, energy, and internet of things.
24. Vermesan Ovidiu, Friess Peter, Guillemin Patrick, Gusmeroli Sergio, Sundmaeker Harald, Bassi Alessandro, Jubert Ignacio Soler, Mazura Margaretha, Harrison Mark, Eisenhauer Markus, Doody Pat, (2011). Internet of Things Strategic Research Roadmap. Internet of Things - Global Technological and Societal Trends, River Publishers, pp.9-51.
25. Weiser, Mark (1993). Some computer science issues in ubiquitous computing. CACM, vol 36, issue 7.
26. Weiser, Mark. (1991). The computer for the 21st century. Scientific American, 265(3):66–75.
27. West, D., (2010). An International Look at High-Speed Broadband. Brookings Institution.
28. Winter J. S. (2012) Privacy and the emerging internet of things: using the framework of contextual integrity to inform policy. Pacific telecommunication council conference proceedings 2012.
29. Zhihao Xing, Yongfeng Zhong (2010). Internet of Things and its future.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE BUILDING BLOCKS OF CONSULTING SERVICE EXCELLENCE

Adeline A. Pacia, Assistant Professor, Department of Industrial Engineering and Operations Research, University of the Philippines Diliman

ABSTRACT

Purpose: *The objective of the study was to identify and address areas that will contribute to the competitive strategy of the service delivery group of a Knowledge Process Outsourcing (KPO) company whose business is focused mainly on the sales and implementation of Enterprise Resource Planning (ERP) solutions.*
Design/methodology/approach: *The DMAIC methodology was used in the study: Define, Measure, Analyze, Improve and Control.*
Findings: *For the company to be competitive, seven* ***Building Blocks of Consulting Service Excellence*** *were proposed: (a)* ***Competency Framework*** *which provides a guide for consultants in identifying key competencies needed to ensure high quality consulting service and career growth; (b)* ***Implementation Methodology*** *which serves as a guide for consultants in identifying key competencies needed to ensure high quality consulting service and career growth; (c)* ***Solution Offerings and Value Proposition*** *which are productized solutions specific to an industry or business process; (d)* ***Human Resource Development*** *which programs the skills development and career growth of the consultants; (e)* ***Organization and Management*** *which covers the organizational structure and management team needed to ensure smooth delivery of the service; (f)* ***Infrastructure Support*** *which includes hardware and software platform; and (g)* ***Performance and Rewards*** *which provide a platform to ensure a motivated team committed to the company vision.*
Originality/value: *These Building Blocks provide a structure in ensuring an efficient Human Supply Chain – from personnel recruitment to human resource development to career transitions and retirement. As a Knowledge Process service provider, the quality of the company's employees is critical to both the success and key to its competitiveness, and the success of their partners and the clients it serves.*

Category: Conceptual Paper
Keywords: Performance Measurement and Management, Knowledge Management, Human Resource Management, Competitive Strategy, Quality Improvement and Management, Organizational Development

INTRODUCTION

Background of the Study

Knowledge Process Outsourcing (KPO) is now an emerging sector that promises to provide long-term jobs for intellectual, analytical and knowledgeable people with pay scales much higher than that offered in the business process outsourcing sector (Buban, 2013). KPO is defined as the "allocation of relatively high-level tasks to an outside organization or a different group in a different geographic location" (Investopedia, 2013).

A KPO company is a consulting service organization in which knowledge- and information-related work is carried out by workers in a different company or by a subsidiary of the same organization. This subsidiary may be in the same country or in an offshore location to save costs or other resources. Companies resort to KPO when they have a shortage of skilled professionals and have the opportunity to hire skilled workers earning lower wages in another location for a lower overall cost. KPO include long-term jobs for intellectual, analytical and knowledgeable people within industries such as research and development, financial consultancy and services, business and technical analysis among others (Investopedia, 2013).

An Enterprise Resource Planning (ERP) solution implementation company is an example of a KPO focused on IT consulting services. For an ERP solutions implementation company, strategy must go beyond simply improving efficiency.

Competitive strategy refers to how a company competes in a particular business. It is concerned with how a company can gain a competitive advantage through a distinctive of competing (Harvard Business School, n.d.). Competitive strategy should address areas of customer care, speed and quality. These will differentiate the company's service delivery from its competitors. The competitive strategies identified cover inputs, processes, outputs and the organizational development activities across these three.

Objective of the Study

The study aims to identify and address areas that will contribute to the competitive strategy of a KPO Company whose business is focused mainly on the sales and implementation of ERP solutions.

As an ERP solutions implementation company, the study took into consideration the different technologies and service offerings, the structures and accompanying policies for the service activities, and the organizational development plans to support and complement the different technologies. Initial implementationwas tested on the SAP Business Solution. It can be applied t other technology-enabledBusiness Solutions of an ERP solution implementation company.

Significance of the Study

Organizational Development (OD) is the process through which an organization designs, creates, and builds physical and logical structures and processes,that will link together and combine all the actual and potential resources that will enable it to perform its functions and deliver its mission. OD develops the internal capacity to be the most effective in its mission work and sustain itself over the long term (MMS Institute, 2013). Input from and collaboration with partner organizations and clients in the company's Organization Development initiatives will bring competitive advantage.

The value of this study is to provide a structure in ensuring that the physical and logical structures and processes of the company are in place. As a Knowledge Process service provider, it is imperative to institute an efficient Human Supply Chain – from personnel recruitment to human resource development to career transitions and retirement. The quality of its consultants/employees is critical to the success of the company and key to its competitiveness. A competency-based recruitment and selection process increases the success rate of personnel hiring, training and regularization to full-time employees. It also provides an objective process of selecting candidates for career advancement and promotions. Likewise, the support infrastructure needed to complement the Human Supply Chain is also identified and defined.

OPERATIONAL CHALLENGES

As a Knowledge Process Outsourcing company, its principal operations are highly dependent on human resources. The depth and breadth of the consultants' skills are critical inputs to the successful delivery of the company's services. The main challenge to a Knowledge Process Outsourcing company is ensuring a smooth and efficient Human Supply Chain and a strong support infrastructure.

Human Supply Chain

The following issues are symptomatic of the real problem on Human Supply Chain:

1. To optimize opportunities, consultants are sometimes sent to projects even without the proper skills training required for the project. Consultants are sometimes forced to learn on the job;
2. Consultants are shared among several projects without clear schedules and guidelines;
3. Consultants assigned to projects are sometimes asked to address *Application Support* issues of other projects as well;
4. The skilllevels of consultantsare not always aligned with the skills required in the delivery of the project;
5. Extended work hours of the consultants;
6. Re-work or back jobs that affect the project schedules;
7. High burn-out rate of consultants; and
8. High attrition rate.

Evaluating these symptomatic issues through the lessons learned in each project, the skills and process gaps identified were:

1. Lack of a structured assessment tool to identify the current competencies of the consultants and the gaps from what is needed by the project;
2. No concrete *Training Plan* to address the gaps in skill sets; and
3. Inadequate *Resource Loading* and *Resource Management*.

These problems can be addressed through the implementation of a *Competency Framework* and a clear *Human Resource Development Plan*. The *Competency Framework* identifies the key competencies required for the different roles and levels in the organization. It provides a tool to assess the individual's competency level and gaps in order to identify the necessary training to address the gaps. With a more accurate assessment of competencies and competency gaps, resource loading can be better planned and managed.

Support Infrastructure

The following issues are symptomatic of the problems on Support Infrastructure for an ERP Solutions Implementation company:

1. Inconsistency in the implementation processes among projects resulting to varying implementation timelines for similarly-scoped projects;
2. Frequent project implementation delays;
3. Delays sometimes due to lack of available equipment or delayed delivery of system infrastructure;
4. Similar projects are implemented from scratch because lessons learned from past projects are not acted upon to prevent the occurrence of past mistakes, which in turn makes project implementation vulnerable to and dependent on the skill level of the consultants;
5. Over-commitment of sales people on the project deliverables in order to make the sale;
6. Variable or reduced profit per project; and
7. Delayed billing and collection due to lack of triggers in the system and processes.

Evaluating these issues, the following possible gaps were identified:

1. Lack of structured project implementation methodology to ensure consistency and timeliness of process execution;
2. Opportunity to standardize solutions delivery offerings from lessons learned in previous implementations not maximized;
3. No clear performance assessment and rewards system to highly encourage quality and timely project implementations with managed customer expectations; and
4. Planning and forecasting for hardware and software requirements can be improved to ensure availability of support infrastructure in a timely manner.

These issues can be address by putting the support infrastructures in place. These would include the implementation methodology; standardized implementation packages for specific industries or business processes; packaged hardware, software and network components of the system architecture and the solution implementation team per solution offering.

THE BUILDING BLOCKS OF CONSULTING SERVICE EXCELLENCE

The study proposes the development of a competitive framework for an ERP Solutions Implementation company. Entitled ***"The Building Blocks of Consulting Service Excellence"***(Figure 1), it will cover the seven areas.

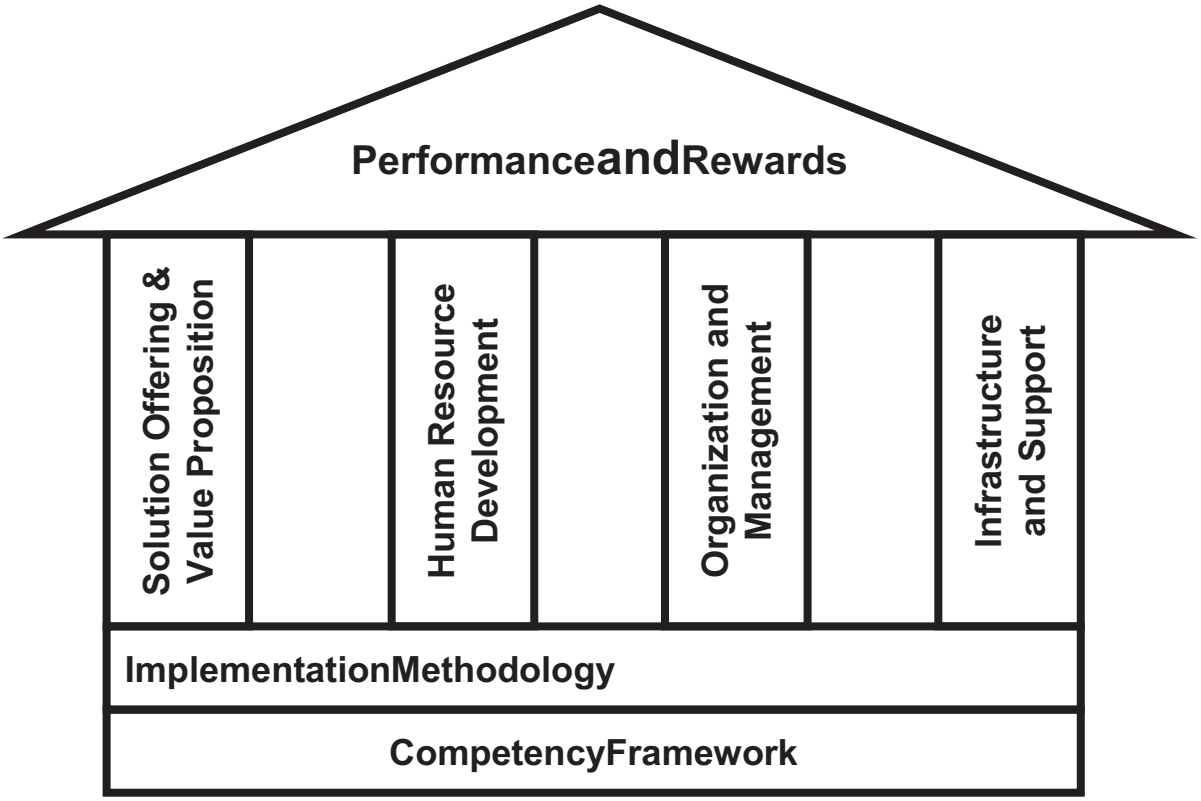


Figure 1. The Building Blocks of Consulting Service Excellence

Competency Framework

The Competency Framework is an approach to link company objectives to individual performance and should be part of the company's organization development initiative. This will provide a guide for the consultants in identifying key competencies needed to ensure high quality consulting service and career growth. This is a key component of the organizational development work needed to bring the consultants/employees to the skill level required to deliver quality service.

As the Competency Framework sits at the core of the program and lays the foundation of the Building Blocks and the entire infrastructure, it is the critical input to the processes and output of Competitive Strategy. Its principal operations are highly dependent on human resources. As a consulting company delivering process consulting, system implementation and support services

in partnership with their clients and their respective teams, their clients' own human resources are also critical in the success of company's service delivery. The depth and breadth of the consultants' and project team's skills are critical inputs to the successful delivery of the company's services. Thus, the Competency Framework will cover the following:

- Competency Framework Concept
- Competency Tracks
- Assessment and Upgrade Policies
- Cross-Track Assessment

The Competency Framework not only identifies the competencies within the process areas and functions across the implementation methodology, it also provides a structure to move up the competency ladder. The competency-based Performance Management and Career Development Programsupports and reinforces the Competency Framework. Its rationale is to take performance management a step forward towards increasing the competitiveness of the firm in terms of increased speed and high quality of service to its clients.

Human Resource Development

Organizational development to ensure high quality consultants will deliver high quality work output. This programs the skills development and proficiency needed to move from one level to the next and is tightly knit with the Competency Framework. Each training and certification requirement is a step forward to the next competency level.

- Training Plan
- Certification Requirements
- Career Development

Organization and Management

The organization should be set-up to ensure focus on customer service and customer care. It should be the consultants' top of mind to serve the customer with fast quality service. Teams will be identified to support identified solution sets and customer group. It includes the organizational structure and the management team needed to ensure smooth operations in the delivery of service.

- Organizational Chart
- Management Team
- Policies

Implementation Methodology

The company will develop its own implementation methodology that is an enhanced version of the standard methodology of the given technology. Picking up from all the lessons learned from past implementation experience, it will identify key differentiators to ensure a faster delivery cycle, higher quality service and client ownership of the system at the onset. This details the phases and activities and the corresponding deliverables and Quality Assurance checkpoints to

complete the implementation project from hand-over from Sales to Delivery and then hand-over to Support. The implementation methodology covers the processes to ensure a successful project implementation.

- Sales and Marketing
- Enterprise Solution Delivery
- Packaged Solution Delivery
- Post-implementation Application Support

Solution Offerings and Value Proposition

The focus of solution development efforts will be on productizing solutions specific to an industry or business process. Productization entails customizing the system to address specific needs of an industry, packaging the solution for proper sales and market positioning, setting up templates for fast and repeatable implementation success and ease of support after the implementation. This will ensure quality delivery from sales and marketing to delivery and support. It also covers corresponding pricing strategies for each set of solution offerings. The following are the strategic output from the technology (input) and the implementation Methodology (process):

- Solution Offerings
- Solution Map
- Industry Roadmaps

Infrastructure and Support

This identifies the strategic infrastructure support needed for product development, operational efficiencies, system and information security, knowledge management. This covers the support processes needed to efficiently deliver service, recognize and book revenue, and effectively collect payment when due. It also includes the hardware, software and network infrastructure needed to support the delivery team in their research and development activities and project implementation activities.

- System Development Landscape
- Production System Landscape
  - Internal Systems
  - Applications Support

Performance and Rewards

This provides a platform to ensure a motivated team committed to the company vision, goals and objectives and the individuals' self-fulfillment.

- Key Performance Indicators
- Upgrade, Promotion and Merit Increase Policies
- Other Recognition and Rewards

ADDRESING THE HUMAN SUPPLY CHAIN ISSUES

The main challenges of consulting companies lies in the human supply chain, from recruitment to development, career transitions and retirement. The key components of the proposed **Building Blocks of Consulting Service Excellence** addressing the human supply chain issues are *The Competency Framework* and *Human Resource Development*.Human Resource Development includes (1) Career Bands and Career Zones, (2) The Job Design and (3) the Training Plan.

The Competency Framework

The Competency Framework has been used by successful global consulting companies for many years. IBM and Accenture, two of the leading It Consulting companies and large global players, have been using the Competency Framework for over 12 years already.

The proposed general framework identifies the competencies for each function within the Implementation Methodology. It covers the competency requirements from Solution Sales to Solution Delivery to License Maintenance and Application Support Services. Four levels of competencies were defined (Figure 2).

The initial level defines the core competencies needed by the employee to be hired by the organization and which can be applicable across the different roles in the consulting organization. This includes communication skills and customer service orientation. The second level identifies the General Consulting Skills. This includes the skills needed to understand the client's business processes and their business requirements, and to discuss and present the analysis and recommendations to the client. These two sets of competencies form the **General Competencies** of the Competency Framework.

Figure 2. The Proposed Competency Framework

From the general competencies, the framework branches out to four (4) different process areas – **Sales and Marketing, Project Management, Technical skills, Application Support**. This covers the areas following the Service Delivery Methodology – from Sales to Delivery to Support.

Each process area will have their own set of competencies and share common competencies in their areas of intersection. The process starts with **Sales and Marketing**. Proper understanding of the solutions and their market positioning will help in setting expectations and proper scoping of the solution offering.

After the sales process, it is turned-over to the Project Managers for implementation. **Project Management** competencies will include managing the project, managing the account and managing all the stakeholders of the project.

The Project Managers will manage the Project Team composed of the **functional and technical consultants**. In order to properly manage the consultants, the Project Manager must have an understanding of the business processes and technologies to be deployed in the project. Likewise, the consultants must also have an overview of the Project Management Framework to help them understand the Key Performance Indicators (KPIs) of a successful project.

Once the project is completed, it is turned-over to **Application Support**. Application Support will share a lot of functional and technical competencies that the consultants have in implementing the project. As such, they will share the technical and application management tools available from the technology provider. Understanding and acquiring skills in using these tools will facilitate the early and successful resolution of the issues received by the Application Support Team.

As the baton is passed from Project Implementation to Application Support, the responsibility of managing the account is turned-over as well. Taking care of the customer's requirements and being present in the account translates to continued business with the client. Opportunities for additional business are then passed on to the Sales and Marketing process and the cycle is repeated.

On top of each track will be the **Leadership track**. This means that each area requires leadership qualities to move up the competency ladder and into the management track. All areas – Core Competencies, General Consulting Skills, Sales and Marketing, Project Management, Technical and Support will have its own set of competencies and will be presented with their own Job Designs. The Technical area, because of its scope, will expand to various tracks applicable to the clients' business processes. These tracks are Finance, In-bound Logistics, Out-bound Logistics, Manufacturing, Supplier Relationship Management, Human Capital Management, Analytics, Programming and Interfaces, System Administration, Industry Solutions and Supply Management.

All these competency areas taken together form the proposed Competency Framework for an ERP Solution Implementation company.

An example of the Competency Model for the Technical Track and Project Management track is shown in Figure 3 and 4 respectively.

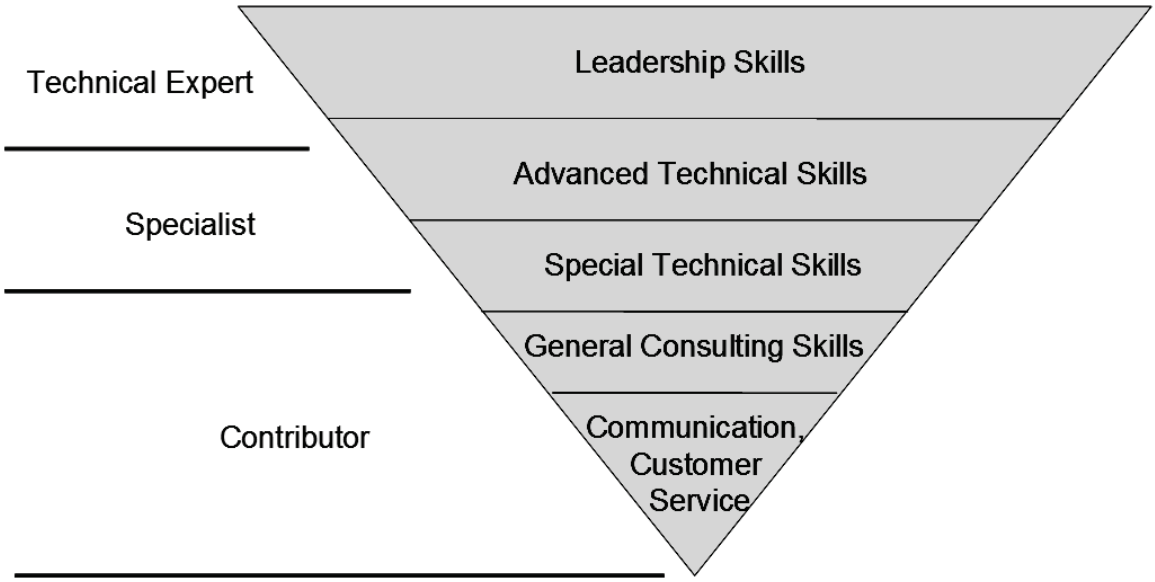


Figure 3. Technical Track Competency Model

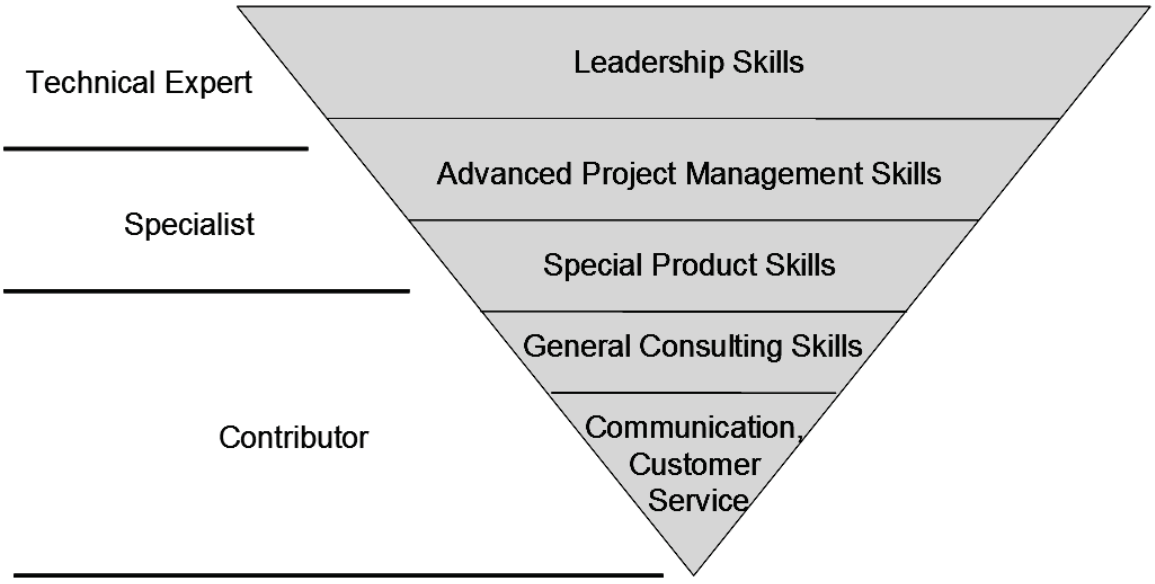


Figure 4. Project Management Competency Model

These Competency Models show the building blocks of skills development from Contributor level to Specialist and Technical Expert / Process Leader levels. It is depicted in an inverted triangle to show that the bigger weight falls under leadership skills. It emphasizes the importance of behavioral and leadership competency in the skills development and career growth of an employee as he moves from the basic communication and customer service skills to basic

technical skills to advanced technical skills until he takes on the leadership role of a track lead or process lead.

Career Bands and Career Zones

The Competency Framework not only identifies the competencies within the process areas and functions across the Implementation Methodology. It also provides a structure to move up the competency ladder. The competency-based Performance Management and Career Development Program supports and reinforces the Competency Framework. Its rationale is to take performance management a step forward towards increasing the competitiveness of the firm in terms of increased speed and high quality of service to its clients. This program allows the organization to:

- Develop Talents from Within
- Rationalize Investments
- Identify activities that target results, and
- Build for the future

The Career Development Guiding Principles:

- Prioritize career development activities that directly link to business objectives
- The training and development approach will utilize existing, new and innovative methodologies to deliver learning
- Staff development is crucial in building a pool of future leaders and specialists, as such, managers will be evaluated based on the development of their subordinates
- Reward people who welcome, seek and contribute in building their own and other employee's talents
- Provide employment security based on the individuals' performance and competencies, the business objectives and the organization's directions

Following the Guiding Principles above, the Career Development and Management Framework was formed (refer to Figure 5). It shows how the company's Mission and Vision statements are cascaded to respective objectives of a Business Unit and Functional area. Within each functional area, the process of staffing and selection is mapped across the performance management system. The components of performance management system include both the behavioral/leadership and the technical competencies and how it is translated to an individual's performance through the Key Performance Indicators (KPIs). This Competency Framework then serves as the backbone of the Career Development Program. With the identification of the competencies within each role or function in the organization, high potentials can be identified and developed faster. The corresponding pay scale can likewise be identified and aligned to the career path.

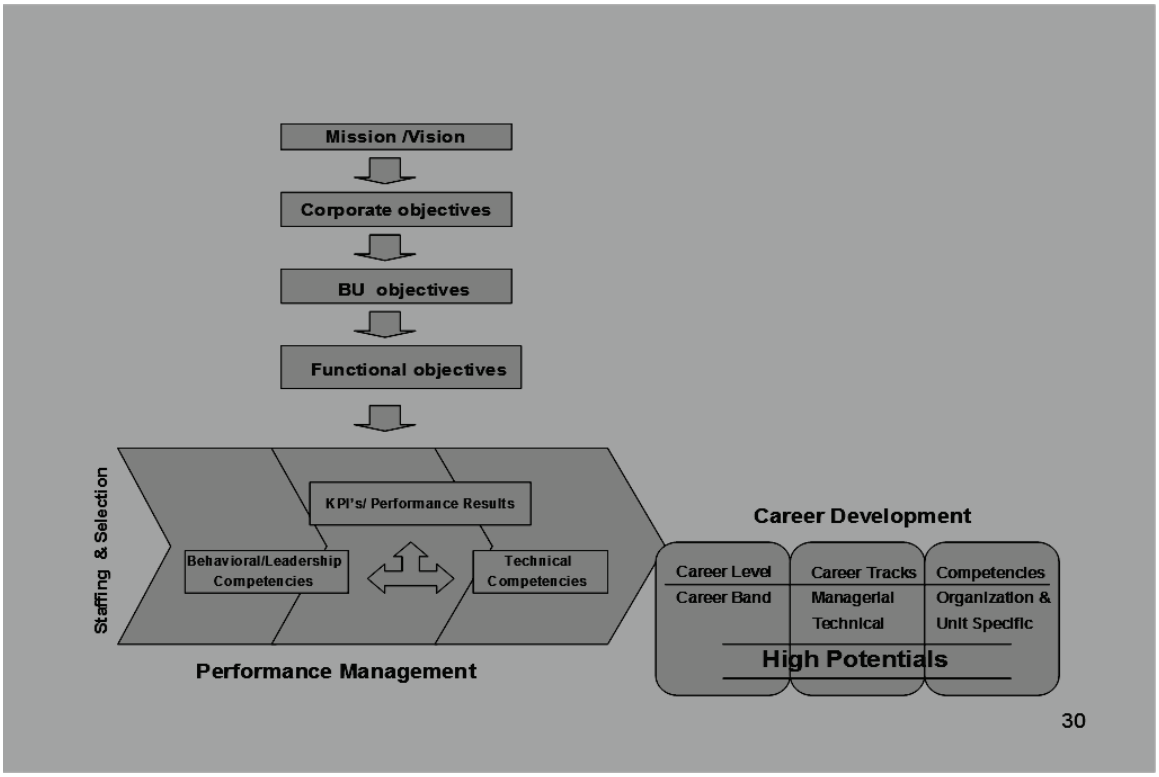


Figure 5. Career Development and Management Framework

There are four (4) career bands – Contributor, Specialist, Technical Expert and Authority/Consultant (refer to Figure 6). **Contributor** is the entry level for the job. The Contributor exhibits application of skills in developing and implementing solutions to commonly anticipated programs, impacts team goals thru own independent work in contribution to team effort. As one increases technical competency in the job and can assume a team lead or supervisory role, he moves up to the Specialist career band. The **Specialist** employs training and broad experience in solving complex problems, influence company goals, tactical plans and programs His work significantly impacts group/division goals, can coach or train others. As the technical competency is further increased and leadership and mentoring skills further developed, he moves up to the Technical Expert band. The **Technical Expert** advises senior management to pursue technical directions, work significantly impacts own group /division/ goals and other major groups/divisions, and can design/innovate major programs and processes. Further up the career ladder is the **Authority/Consultant** level. Being at this level significantly influences company direction, policy, mission and vision. His decision and actions impact the direction of the entire company.

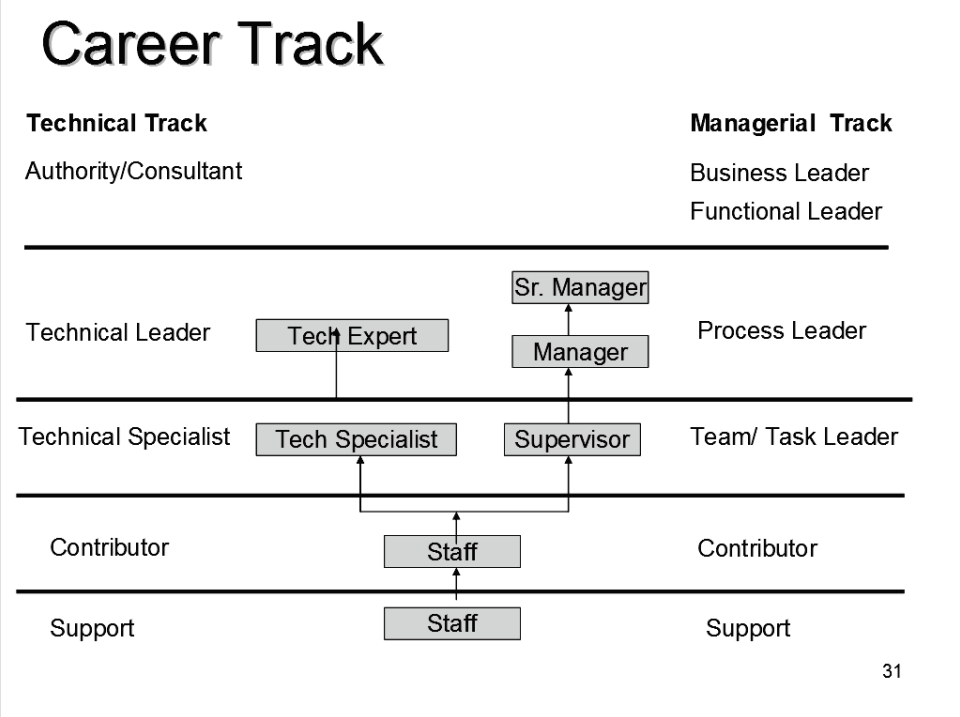


Figure 6. Career Tracks

Within each career band there are three (3) career zones, namely – Learning, Competent and Mature. The Learning zone is the entry point of a career band. It is where the employee gets introduced to the career band and learns the competencies required of that career band. The Competent zone is when the employee gets to display the competencies he learned at the expected proficiency level. As the employee masters the competencies of the career band and is able to apply it in a wide variety of situations without assistance, he qualifies for the Mature zone. Then the employee goes thru these three career zones all over again when he moves to the next career band where he learns, becomes competent and matures in the job and is ready to move to the next career band again.

The Job Design

Job design involves envisioning and defining the specification of work systems related to a particular job. It is an activity to ensure that people and other resources are effectively and efficiently utilized in delivering quality service and system implementations. Job design is undertaken, keeping in mind job satisfaction and performance, not only from the point of view of the organization but from the clients it serves. The Job Design should be validated annually for the first three years to determine its effectiveness and impact on the quality of service to the clients.

Each process area will have its own set of competencies per career band and career zone. These will be reflected in their respective Job Designs. A Job Design details the list of competencies relevant to a specific job or role and their corresponding level of importance as well as the expected proficiency level as the person moves up the career ladder. The Job Design is the scorecard that indicates the minimum score for each career zone within each career band. The score is the sum of the weighted proficiency level (importance level multiplied by the rated proficiency) The Importance Level ranges from 1 to 3 with 3 being the highest level. The Proficiency level ranges from A to D with the numerical equivalence of 1 to 4.

The Proficiency Level is the expected performance of an individual at a certain level. The four (4) levels are A to D as detailed below.

(A) Conceptual knowledge – understands concepts but infrequently applies knowledge; familiarity with terminologies gained thorough readings, briefings, observations; application of basic knowledge or overview; minimal judgment and analysis required (WHAT)

(B) Working knowledge – applies knowledge and experience to mostly routine situations; application of working and functional knowledge and capability in a particular process or method; perform independent action according to acceptable standards and guidelines, may require minimal assistance in unfamiliar situations (WHAT AND HOW)

(C) Thorough knowledge – consistently applies thorough knowledge and experience to a wide variety of situations; has hands-on competence in content area, able to troubleshoot many or most situations without assistance, demonstrates professional discernment and judgment when appropriate (WHAT, HOW, WHY AND WHAT IF)

(D) In depth expertise – high degree of mastery in content area, specialized knowledge enabling advanced analysis and problem solving, innovates, designs systems, processes and approaches, influences critical decision and actions through application of expert opinion and advice (TEACH AND INNOVATE)

The Job Design serves as the guide in rating the current employee's competency level and identifying the areas for improvement and training needs to move him to the next career zone and/or the next career band. The Job Design is a very useful tool in performance evaluation as well as employee selection and recruitment.

In order to balance the competencies per track, alignment of the competency blocks and descriptors will be done so as to group them and come up with equivalences. This will allow the competencies or groups of competencies to total to an equivalent number. This will then serve as a guide for cross-training and up-training. The expansion of competencies will contribute to the increase in job scope and expertise of the consultants for their career development and the company's competitive advantage in delivering cost effective quality service to their clients

The Training Plan

A training plan is a component of a company's training system. A company's training system identifies and addresses the training needs of the company aligned with the company's objectives. It covers a four-tiered analysis of the company's training needs namely - an organizational analysis, a job analysis, a person analysis and a client-needs analysis.

An organizational analysis is used to identify company factors that can impact the effectiveness of the training program, such as the training budget.

A job analysis is the process of identifying the skills to be learned and training activities required to successfully perform a job. The Training Plan is a document that details the training and certification requirements for each job. It involves an examination of the tasks involved in each job and the identification of the corresponding training objective. The objective should identify what the skill is, how the trainee is to learn the skill and how proficient the trainee needs to be in the skill after the training is completed. The Training Plan is needed to maintain a common standard of training for all employees for performance assessment and a guide to employees of the company's expectations.

A person analysis is the identification of the employees needing training and what specific training they need. Input from the past and current performance appraisals and competency assessments are used to identify the specific employee's training needs and individual Training Plan. The Performance Appraisal Form is used for both mid-year and annual performance assessment as well as employee regularization assessment. Citations and areas for improvement are indicated and serve as input to identifying the individual's training needs for the next period.

A client needs analysis is geared towards identifying the core competencies needed to address and deliver, not just quality customer service, but excellent customer service. This is a critical aspect that needs to be considered in the company's competitive strategy. The company gets feedback from the client through the Customer Satisfaction Survey forms to be given at the end of the project. Client assessment is taken for the Project Manager and the consultants. A Training Plan imbedding excellent customer service should be covered by the company's corporate training program. These are the soft skills complementing the technical, project management and support service competencies.

Even sales and marketing, instinctively geared towards customer service, will benefit from this. It is not uncommon that technical people transition to pre-sales then to sales and marketing. Corporate training encompassing communication and presentation skills development, general consulting skills and excellent customer service will support the employees' career development and provide options for the employees who may want to shift careers. But more importantly, the focus on understanding the clients' needs and the level of service needed to address those needs is a key component of the Training Plans.

METHODOLOGY

The Career Development and Management Frameworkfollows the Organizational Development Framework. With this, the general Competency Framework of the Implementation Methodology should be developed. From the feedback of the clients and the lessons learned in previous projects, the study looked at Structures, Processes and the People components of Organizational Change Management as follows:

1. **Structure Development**

   The components of the Structure Development are:

   a. Identification of the different technical tracks
   b. Research on the technical competencies as the initial set
   c. Validation and refinement
   d. Creation of the Job Designs
   e. Development of the Training Plans

The development of the structure was initially based on the different modules of the SAP System. From there, the competencies were expanded to include the understanding and knowledge of the business processes they support and the rationale for such competencies. The structure was enriched by the input from the clients and results of the Quality Assurance (QA) checks done on previous projects.

2. **Process Development**

   The components of the Process Development are:

   a. Competence Assessment
   b. Recruitment and Selection
   c. Performance Evaluation

The process of using the Job designs from recruitment to performance evaluation and career development should be tested and continue to be validated through the results of the projects implemented. It is an iterative process and should be validated at least once a year.

3. **People Development**

   The components of the People Development are:

   a. Human Resource Team
   b. The consultants
   c. The Management Team and Track Leads

Input from the validation of Process Development above feeds the human resource development – from the consultants/employees to the track leads and the management team to the entire organization.

SUMMARY, VALIDATION AND RECOMMENDATIONS

Organizational Development is the process through which an organization develops the internal capacity to be the most effective in its mission work and sustain itself over the long term. Input from and collaboration with partner organizations and clients in Organization Development initiatives will bring competitive advantage. Organizational Development is a long and tedious process but is essential in the growth and success of any organization and the organizations of their customers. The Chief Executive Officer or Executive Director's role is vital to the success of any organizational development work. And the involvement of the board, management team and staff, partner organizations and clients is essential. The stakeholder base for organizational development work should be extended not only to clients but to the academia involved in national competitiveness and productivity improvement as they provide the input to the human supply chain. Organizational Development is a never-ending process so pacing the work is wise.

This study on the Building Blocks of Consulting Service Excellence focused on the Competency Framework and Human Resource Development and tested on the SAP Technology in an ERP Solution Implementation company. It covered the processes from Sales to Delivery to Support on the conceptual level. The execution was limited to the technical tracks. Job Designs were done for four (4) sample tracks – Financial Accounting and Controlling, Supplier Relationship Management, Analytics and System Administration. These tracks were chosen as they represent the different SAP solutions and services, namely, the core Enterprise Resource Planning (ERP) solution, the extension solutions, the Business Consolidation and Enterprise Reporting solution, and the Technical Services. Financial Accounting and Controlling falls under the core ERP solution. Supplier Relationship Management falls under the extension solutions, Analytics is the business Consolidation and Enterprise Reporting solution while System Administration is one of the SAP Technical Services.

The Training Plans were likewise developed for each sample track and accomplished for each employee within that track and eventually, for the entire organization. This then serves as a guide for both the Track Lead and Human Resources to schedule the training courses and list the attendees accordingly. It also informs the employee ahead of time to plan for these training courses and certification requirements he is expected to complete within the year. These requirements are part the Organizational and Personnel Development component of his Key Performance Indicators (KPI) for the year.

The Job Designs and Training Plans of the selected pilot tracks were completed and validated. The Competency Profile of each track was used to identify competency gaps and determine which will be filled through recruitment, up-skilling through training or cross-training from other tracks. The results were also used as basis for salary upgrades and promotions. The Job Designs are also used to assess applicants with prior SAP experience and determine if their competency level falls under the requirements of the track. Job offers are then more aligned to the competency levels.

In sum, the Competency Framework has been very helpful in the proper assessment of skill levels of both employees and applicants. It is a very objective approach to performance assessment and a good basis for determining the compensation and benefits packages offered to employees as it is very much aligned with the revenue performance of each track.

The Competency Framework has also been well received by the employees as it provides a clear guide to career development and growth and a proactive approach to excellence in service delivery to the clients. It benefits the individual employees with the structured approach to skills development and learning. It benefits the leadership of the organization with the alignment of the Competency Profile and the Revenue targets and a vital input to Resource Loading and Management. This will also impact the organization's culture with emphasis on performance and value and provide the needed structure and processes to support the company's performance goals.

The Competency Framework is also expected to benefit clients and partners in terms of providing the appropriate skill level of the consultants assigned to deliver the company's services to the clients. With the proper alignment of the competency levels with the contracted service to be delivered to the client, there should be an increase in the success rate of projects and an increase in customer satisfaction. Happy customers translate to repeat business and client referrals which hopefully translate to increased business and the company's growth and success.

REFERENCES

1. Buban, C.E., (2013), "Growing KPO market to spur homebuilding outside Metro Manila",Philippine Daily Inquirer,11January,http://business.inquirer.net/102255/growing-kpo-market-to-spur-homebuilding-outside-metro-manila/ (accessed 10 March, 2013).
2. Harvard Business School. (n.d.). "Competitive strategy", http://www.isc.hbs.edu/firm-competitve.htm/(accessed 15 January, 2013).
4. "Knowledge process outsourcing – KPO", (2013), Investopedia. http://www.investopedia.com/terms/k/knowledge-process-outsourcing.asp#axzz2NKq47nAj/ (accessed 10 March, 2013).
5. "Knowledge process outsourcing (KPO)", (2013), BusinessDictionary.com. http://www.businessdictionary.com/definition/knowledge-process-outsourcing-KPO.html/(accessed 10 March, 2013).
6. Mind Tools, (2013),"Developing a competency framework",http://www.mindtools.com/pages/article/newISS_91.htm/(accessed 10 March, 2013).
7. MMS Institute, LC, (2011),"Management consulting",http://www.themms.com/corporate-education?id=109/ (accessed 17 November, 2012).

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

RELATIONSHIP PERFORMANCE ON SELF-SERVICE TECHNOLOGY: RELATIONSHIP MAINTENANCE AND PERCEIVED RELATIONSHIP INVESTMENT

Powen Fang, National Cheng Kung University, Taiwan
Email: r4896104@mail.ncku.edu.tw

Yaochuan Tsai, National Cheng Kung University, Taiwan

Hsinhsin Chang, National Cheng Kung University, Taiwan
Email: easyhhc@mail.ncku.edu.tw

ABSTRACT

Purpose: *This paper extends the dedication-based relationship maintenance mechanism of social exchange theory and customer perceived relationship investment to study the relationship performance of a convenience store launching an in-store kiosk business. Meanwhile, computer anxiety and time consciousness are hypothesized to moderate the effects among the relationships.*

Design/methodology/approach: *Results of data analysis, with in-store kiosk use experience data collected for 211 in-store kiosk users, supported our model.*

Findings: *Our results confirm that dedication-based relationship maintenance is related to perceived relationship investment. Higher levels of customer-perceived relationship investment impact relationship performance. Computer anxiety and time consciousness act separately as both partial and full moderators.*

Originality/value: *We found that the businesses that launch in-store kiosk businesses determine customer perceptions of relationship investment. This study found that customers with computer anxiety have an anchor to the use of technology. customers who think of time as a resource escalate the effect between their perceptions that a business has invested effort in relationship building and the development of customer loyalty.*

INTRODUCTION

There are more and more businesses launching SST businesses intended to provide efficiency and to gain benefits, especially Taiwanese convenience stores e.g. ibon (7-11), Famiport(Family Mart), LifeET(HiLife) (Chiu, Fang, & Tseng, 2010). Thus, the development of SST strategies for convenience stores that maintain customer relationships is gradually becoming an important issue related to gaining e-business profit (Ou, Hung, Yen, & Liu, 2009).

Kim and Son (2009) pointed out that a dedication-based relationship maintenance mechanism is one of the strategies for keeping loyal customers. It is based on social exchange theory (SET). However, very few studies have discussed the link between customer perceptions of how businesses invest their resources in relationship maintenance and their loyalty reactions, especially in the case of SST businesses (Zhu, Nakata, Sivakumar, & Grewal, 2007). Accordingly, convenience stores operate SST business that launch their resources toward keeping loyal customers by providing merchandise variety from products/services complemented by in-store kiosks, the provision of both quality e-services and a novel shopping experience that evokes customer dedication toward maintenance of the business relationship (Wells, Campbell, Valacich, & Featherman, 2010).

Therefore, some people feel anxious about the use of computers (Cambre, & Cook, 1985). A few studies have suggested a relationship between the cognition of customers with computer anxiety to the relationship between e-business loyalty maintenance strategy and customer perceptions of e-business investments of their resources in relationship building. Hence, this relationship becomes an important issue for business intending to launch in-store kiosk businesses for the purpose of gaining a higher market share.

Accordingly, the closing of these research gaps could contribute to SST research in four ways: Firstly, this study is based on a dedication-based relationship maintenance mechanism derived from social exchange theory (SET) in in-store kiosk businesses in convenience stores to discuss customer perceptions of relationship investment related to committing to in-store kiosk business operations. Secondly, this study probes into how customer perceived complementarity features of in-store kiosk retailing both directly and indirectly impact relationship performance through perceived relationship investment perceptions related to customers' post-purchase behavior. Thirdly, this study is intended to determine whether a dedication-based relationship mechanism plays an important role in reducing customer anxiety related to the use of computers and also to determine customer perceptions of

convenience store investment of resources on building customer relationships. Finally, this study will verify the moderating role of time consciousness on the relationship between customer perceived relationship investment and SST relationship performance. It will determine whether or not customers with time consciousness are the target customers and whether these customers have intention toward loyalty to in-store kiosk businesses.

THEORETICAL BACKGROUND AND CONCEPTUAL FRAMEWORK

Self-service Technology; In-store Kiosk

Meuter, Ostrom, Roundtree, and Bitner (2000) proposed that SSTs are 'technological interfaces that enable customers to produce a service independent of direct service employee involvement'. SST has been widely applied for many purposes. One noticeable trend is the increasing use of SST by businesses (Ou et al., 2009). Zhu et al. (2007) specified that SST in physical stores that operates for the purpose of customer transactions are called "in-store kiosks". In fact, in-store kiosks are a kind of business which can help customers independently finish their purchase tasks. Accordingly, in-store kiosks in Taiwanese convenience stores that provide distinctive characteristics (e.g. the sale of tickets, among other services) can also provide user time savings and efficiency when purchasing. Meanwhile, efficient shopping strategies and convenience store launches customer relationship investment lead to the benefit of keeping customers who think time is an essential concern.

Dedication-based Relationship Maintenance

Dedication-based relationship maintenance is based on attitudinal commitment resulting from genuine appreciation for the relationship. On the other side, constraint-based relationship maintenance centers on locked-in "economic, social, or psychological" commitment (Kim & Son, 2009). In other words, the users invest their economic, social, or psychological resources when purchasing.

According to information technology studies that have specified that information technology for business which focuses on ease and usefulness of system design (Delone & McLean, 2004; Rogers, 1983) will provide functional information technology for businesses that will attract the customers' genuine appreciation for the relationship. Indeed, the convenience stores in Taiwan usually adopt the characteristics which result in users perceiving a quality function from their purchasing processes (Delone & McLean, 2004). Hence, this study

focused on convenience store launches of dedication-based relationship mechanisms in in-store kiosk businesses and discusses business relationship-building performance.

Perceived Relationship Investment

De Wulf, Odekerken-Schrod, and lacobucci (2001) developed a model that pointed out that retailer direct their marketing efforts to evoke customer perception that the retailers are investing their resources in developing long-term relationships. As a result, loyalty intentions will develop. Convenience stores launch in-store kiosk businesses (Zhu et al., 2007) to provide customers with a new shopping method intended to fill customer needs for efficiency and time saving features. Hence, this study defined perceived relationship investment as customer perceptions that the convenience store has invested resources in long-term relationship building through the use of in-store kiosk business operations. Hence, this study proposes that dedication-based relationship mechanisms launched by convenience stores are related to perceived relationship investment and relationship performance.

Relationship Performance

The length, breadth and depth of customer purchasing behavior is a measurement of customer's loyalty behavior (Bolton, Lemon, & Verhoef, 2004) This information can result in business owners having a more in depth understanding of the loyalty relationship. Accordingly, relationship performance includes relationship length, relationship depth and relationship breadth, and it is illustrated as below:

Relationship Length

Bolton et al. (2004) proposed that the "duration" of a transaction is the length of the relationship. Convenience stores create strategies for customer relationship building, e.g., merchandise variety in in-store kiosks, quality service, and novel shopping experiences, among others, that will determine the customer's intention to make long-term purchasing behavior in the future (De Wulf et al., 2001). Thus, relationship length is defined as customer willingness to transact with certain in-store kiosks in convenience stores in the future.

Relationship Depth

Relational depth is measured by "how often" a customer purchases in a certain store (Bolton et al., 2004). In this research, this was called "frequency of purchase". Indeed, customers

having positive relationship investment perception with regard to a retailer will determine to commit to the relationship (De Wulf et al., 2001). Hence, relationship depth is customer willingness to frequently transact in certain in-store kiosks in convenience stores.

Relationship Breadth

Bolton et al. (2004) found that relational breadth is measured by customer "cross-buying intentions". Customers performing cross-buying in certain stores help the store create unexpected revenue (Zhang, Fang, Wei, Ramsey, McCole, & Chen, 2011). Accordingly, customer perceived the convenience store do their marketing effort in evoking customer positive SST relationship investment perception. These perceptions will evoke customer commitment to the transaction relationship (De Wulf, 2001). Hence, relationship depth is customers intention to conduct cross buying behavior in certain in-store kiosks in convenience stores.

Accordingly, the conceptual framework guiding this study is presented in Figure 1. This study employed the dedication-based relationship mechanism from social exchange theory (SET) to discuss customer perceived relationship investment toward an in-store kiosk in a convenience store. Meanwhile, we discuss customer computer anxiety as having a moderating effect between the dedication-based relationship mechanism and perceived relationship investment. We also discuss customer time consciousness as a moderator between perceived relationship investment and related relationship performance.

Figure 1 here

RESEARCH HYPOTHESES DEVOELOPMENT

The influence of dedication-based relationship maintenance on perceived relationship investment

Katz and Shapiro (1985) based their research on Metcalfe's law and argued that indirect network externality is *perceived as complementarity*. Perceived complementarity is the user base expands; users can get lots of complementarity functions and services which bring additional value.

Taiwanese convenience stores apply perceived complementarity of perceived network externality to launch in-store kiosks in order to provide efficient shopping. In fact, in-store

kiosks in convenience stores have various products/services that help customers make efficient purchases. In-store kiosks represent complementarity features such as ticket purchasing, paying bills, and copy machines complimented in in-store kiosk businesses) to generate customer benefit perceptions (Kim & Forsythe, 2008). Indeed, synergy will be generated.

According to reciprocal theory (Huppertz, Arenson, & Evans, 1978) "relationship investment emphasizes an aim for reciprocation by consumers that is based on retention efforts made by a retailer". Meanwhile, social exchange theory (SET) specifies that if businesses provide benefits that can be delivered to the customers, it will determine their future behavior (Kim & Son, 2009). In-store kiosks have various products/services that benefit customers. Therefore, customers will perceive the convenience store to have made positive relationship investment in in-store kiosks. Hence, Hypothesis 1 is as follows:

H1: *Customers perceiving a high degree of complementarity associate with higher perceived relationship investment with regard to in-store kiosks in convenience stores.*

E-service quality means an overall judgment of a service with more of an emphasis on consumers personal feelings regarding the process of service delivery, which contributes to user satisfaction, purchase intentions, and in turn, to firm performance (Yang, Cai, Zhou, & Zhou, 2005). Accordingly, e-service quality is defined as "consumers' global judgment related to the superiority of the in-store kiosk of the convenience store that they have chosen".

This study applies the e-service quality measurement of Lin and Hsieh (2011) to discuss an in-store kiosk service quality evaluation. Accordingly, e-service quality includes the following dimensions: First, functionality means that the in-store kiosk provides a stable function for customers' smooth and effective manipulation. Second, enjoyment implies that the in-store kiosk service provider usually provides interesting content that evokes customer enjoyment perceptions, e.g., interactive games. Third, security represents the idea that customers can manipulate in-store kiosks that can protect their personal information e.g., ID number. Fourth, assurance is that the convenience stores which provide in-store kiosks have a good reputation. Fifth, design indicates that the in-store kiosk has invested resources in a platform designed from customer perceptions, e.g. invested in up-to-date, aesthetically appealing technology. Sixth, geographic density will lead customer perceived convenience. Hence, convenience means the in-store kiosks always exist in the main Taiwanese convenience store. Taiwanese convenience stores have high geographic density. The more

customers perceive convenience, the more positive is their relationship investment perception. Lastly, customization means the in-store kiosk can fulfill customers' specific needs. For example, an in-store kiosk in a convenience store can allow the purchase of registered airline tickets.

Reciprocal theory (Huppertz et al., 1978) has pointed that "relationship investment emphasizes an aim for reciprocation by consumers that is based on retention efforts made by a retailer". Kim and Son (2009), on the basis of social exchange theory (SET), pointed out that e-customers will receive benefits from an online business provided to adjust their future behavior. Hence, in-store kiosks provide good service quality that customers can easily use. These benefits will evoke customer perceptions that the convenience store has invested resources in keeping loyal customer relationships with their in-store kiosk businesses. The hypothesis is stated as below:

H2: *Customer perceptions of a high degree of e-service quality are associated with higher perceived relationship investment with regard to in-store kiosks in convenience stores.*

Diffusion of innovation was proposed by Rogers (1983). The main idea is that the technology user's intention to do behavior is affected by the innovator of the network diffusion in the technology product or service context, and it is based on the network effect (Zhu et al., 2007). Wells et al. (2010) argued that past studies do not have a specific construct by which to discuss user perceptions of innovation. Thus, perceived novelty is based on the innovativeness attributes in diffusion of innovation theory. Perceived novelty is the perspective by which to understand the user perceived the business launch the novelty management method which delivers to the customer and it is a benefit for customers using technology products.

Novelty usually attracts customer attentions, and it is a kind of loyalty maintenance strategy from the customers benefits perception (Huppertz et al., 1978). Hence, if customers perceive novelty from in-store kiosk products/services, they will perceive that the convenience store launching the in-store kiosk business has invested resources to keep customers' loyalty. The hypothesis is as below:

H3: *Customers perceptions of a high degree of novelty are associated with higher perceived relationship investment with regard to in-store kiosks in convenience stores.*

The influence of perceived relationship investment on relationship performance

According to the notion of relationship quality theory (Crosby, Evans, & Cowles, 1990), it has been proposed that customer commitment can create long-term relationships. Meanwhile, commitment will be determined by the retailer making an effort to establish customer relationships. In particular, retailer investment of resources in customer relationship building will determine relationship performance.

In fact, in-store kiosks in convenience stores are businesses intended to fulfil customer needs related to efficiency of transactions as well as the convenience store launches resources on building customer loyalty intention through in-store kiosk purchasing. Hence, more efficient shopping and relation maintenance resources launched in in-store kiosk businesses will lead to the generation of more loyal customers (Liang & Chen, 2010). Accordingly, in this study, we posit that customer perceptions that businesses are making an effort in in-store kiosk transactions to fulfil their efficiency transaction needs will result in customer commitment to the relationship, a lengthening of purchasing duration, increases in the frequency of purchasing, and the generation of cross-buying. Hence, the hypothesis as below:

H4: *Customer perceptions of a high degree of relationship investment are associated with higher (a) relationship length (b) relationship depth and (c) relationship breadth with regard to in-store kiosks in convenience stores.*

The moderating effect between dedication-based relationship maintenance and perceived relationship investment

Some people fear computers because they think computer use exhibits a lack of self-efficacy, among other weaknesses (Hackbarth, Grover, & Yi, 2003). E-environments area now wide spread. In fact, technology usually makes things more efficient. Hence, businesses launching technology-related business operations not only are effective but also evoke customer usability perceptions (Collier, & Sherrell, 2010). This study argues that if in-store kiosks in convenience stores have a variety of products/services as a driver, this will evoke perceptions that the convenience store is making marketing effort toward relationship building through the provision of a variety of products/services.

Also, Kim and Forsythe (2008) specified that computer anxiety plays a moderating role in regard to use of technology products. This study argued that a functional information technology platform can reduce customer anxiety (Elie-dit-cosaque, Pallud, & Kalika, 2011).

Hence, quality e-service will diminish customer anxiety toward a technology. Once a user with computer anxiety perceives positive quality in an e-service, this will impact the businesses' continual investment in resources related to relationship building. Hence, this study argues that computer anxiety plays a moderating role between e-service quality and perceived relationship investment.

Finally, convenience stores usually launch in-store kiosks to fulfill customer needs for innovation (Chiu et al., 2010). A novel shopping experience will lead customers to have benefit perceptions of an e-business (Wells et al., 2010). It has been argued that benefit perceptions reduce customer anxiety toward information technology (Elie-dit-cosaque et al., 2010). Hence, customers with computer anxiety will, based on novelty perception of the in-store kiosk use experience, perceive a positive relationship investment on the part of the convenience store in-store kiosk business operation. The hypothesis is as below:

H5: *Computer anxiety moderates the influence of customer (a) perceived complementarity (b) perceived e-service quality and (c) perceived novelty on perceived relationship investment.*

The moderating effect between perceived relationship investment and relationship performance

Some people are concerned about time as resource. They believe that the efficient use of time will lead to an effective life (Kleijnen et al., 2007). Hence, time consciousness in this study is defined as a person's predisposition to consider time as a scarce resource and to plan its use carefully.

Customers are concerned about efficiency and time savings during in-store kiosk use (Collier & Sherrell, 2010). The characteristics of SST are in regards to customer independence and the completion of transactions. Particularly, customers with time consciousness usually think efficient purchasing transactions are one of the most important factors related to their shopping procedures (Kleijnen et al., 2007). Hence, the main purpose of in-store kiosks is fulfilling customers' needs for efficient e-shopping.

This study proposes that customers with time consciousness perceived the convenience store launch their resources in keeping the customers loyalty. This will lead them to be loyal to the in-store kiosk in the future. Thus, this study will deeply discuss the impactions on relationship performance. The hypothesis is as below:

H7: *Time consciousness moderates the influence of customer relationship investment on (a) relationship length (b) relationship depth and (c) relationship breadth.*

METHOD AND DATA ANALYSIS

Pilot Test

A seven-point Likert response scale format that ranged from "strongly agree" to "strongly disagree" was used in the questionnaire in this study. All the construct measurements were modified from previous studies and were consistent with their definitions. We collected 31 paper questionnaires, and we used SPSS 17.0 to analyze the data. Cronbach's alpha and the item-to-total correlation were brought in as the standard items of choice for the main study (Weise, 1975). According to Weise (1975), a level of 0.3 is acceptable for the questionnaire in this study. In the case of the other 67 items, the item-to-total value exceeded 0.3. Therefore, the general requirement of reliability for the research instruments was satisfied. As a result, all 67 items were adopted. There were a total of 67 items used together in the formal questionnaire to measure the constructs.

Samples

Conducting a field survey of a bricks and clicks shopping experience provided the empirical data: An on-line survey (http://www.my3q.com/) was published on a bulletin board system (BBS), which yielded 246 usable responses. 35 questionnaires were eliminated in which the respondents filled in some questions incompletely. Finally, the study had 211 respondents that could be used for analysis. Sample demographics are depicted in Table 1.

Table 1 here

Validity and reliability of the measurement

All of the reliability estimates were higher than 0.8, providing evidence for a high degree of internal consistency among the corresponding indicators. According to Bagozzi and Yi (1988), AVE values greater than 0.5 are considered adequate. As table 2, all the square roots of the AVE were greater than the correlation between the two constructs of interest, indicating that the discriminate validity of the measurement model was satisfied.

Table 2 here

The chi-square was significant ($p < 0.001$), and $\chi^2/df = 2.25$, proving internal consistency between the observations and the theoretical model. The CFI= 0.93, the GFI=0.82, and the RMSEA= 0.08, which achieved the recommended standard. The other indices, NFI= 0.88, and the AGFI= 0.78, which were slightly lower or higher than the recommended values, but all fell within an acceptable range. The above indices proved the research model fit the sample data well.

Hypothesis Testing

AMOS 7.0 was used in this study for SEM analysis, including standardized path coefficients, path significances for each variable and model fit indices, and the results are presented in Figure 2 and Table 3. It can be seen that there are six paths in this model significant at p<0.001*** and one significant at p<0.05**. Customers perceived complementarity between in-store kiosk and variety products/services had a significant effect on perceived relationship investment (γ=0.15***; *t*=2.85), e-service quality had a significant effect on perceived relationship investment (γ=0.70***; *t*=7.07), perceived novelty had a significant effect on perceived relationship investment (γ=0.13**; *t*=2.41), thereby supporting H1, H2, and H3. Perceived relationship investment had a significant effect on relationship length (γ=0.96***; *t*=8.22). Perceived relationship investment had a significant effect on relationship depth (γ=0.91***; *t*=5.90); Perceived relationship investment had a significant effect on relationship breadth (γ=0.75***; *t*=4.99); thereby, H4a, H4b, and H4c were supported.

In fact, every in-store kiosk in a convenience store provides merchandise variety that build complementarity characteristics between the in-store kiosk and its products/services; the strategy is intended to create loyal customers, e.g. a concert ticket that was purchased through an in-store kiosk can be accepted by the organizer; customers can make an efficient purchase without they finding the specific ticket selling point. Accordingly, this study suggests that customer perceived complementarity between in-store kiosk and variety products/services will cause customers to commit to a future relationship with an in-store kiosk in a convenience store.

We conducted a test for the direct effect between customer perceived complimentary and relationship performance (See Table 3). The results shows that perceived complementarity did not have a significant impact on either relationship length (γ=-0.22; *t*=-1.87) or

relationship breadth (γ=-0.10; *t*=-1.80). But perceived complimentary had a negatively significant impact on relationship depth (γ=-0.26**; *t*=-2.27). As a result, perceived complimentary not only has a significant impact on relationship length and breadth but also has a negatively significant impact on relationship depth.

Figure 2 here

Table 3 here

A hierarchical regression was conducted in this study for the purpose of determining the moderating effect between dedication-based relationship mechanism and perceived relationship investment, as shown in Table 5. We found that computer anxiety plays a moderating role between perceived complementarity and perceived relationship investment; however it presented a negative impact on customer perceived relationship investment. Therefore, computer anxiety did not play a moderating role among e-service quality, perceived novelty and perceived relationship investment; therefore, it did not support H6a, H6b, and H6c.

Meanwhile, a hierarchical regression was used in this study to examine whether time consciousness has a moderating role between perceived relationship investment and relationship length, relationship depth, and relationship breadth. The results (see Table 5) showed that time consciousness is a moderator between perceived relationship investment and relationship length, relationship depth and relationship breadth. Hence, H7a, H7b, H7c were supported.

Table 4 here

Table 5 here

DISCUSSION AND CONCLUSIONS

Research Findings

This study found that in-store kiosks provide merchandise variety and in-store kiosk business exhibit complementarity; it will evoke the customers perceived the convenience store invest their resources in relationship developing. Meanwhile, good e-service quality in in-store kiosks also relates to customer perceptions that the company is investing resources in

maintaining customer loyalty intentions. Also, novel in-store kiosk experiences will determine customer perceptions of the convenience store related to their belief that the store is making an effort to maintain relationships. Consequently, H1, H2, H3 were supported.

Therefore, we found that the customer perceived complementarity of dedication-based relationship maintenance mechanism is not only unrelated to relationship length and breadth but also negatively significant impact relationship depth. Kotler and Keller (2010) suggested that businesses using product-oriented strategies have not been fulfilling customer purchasing needs. In other words, the business launches product oriented strategy will be failed because the in-store kiosk in convenience store launched variety products/services without matching their relationship marketing strategy up. Indeed, marketing myopia will be infected by the business launches product oriented strategy (Levitt, 1960). Hence, convenience stores managing in-store kiosks should make an effort to complement their relationship marketing strategic slotting strategy in in-store kiosk business running.

This study found that customers perceiving an effort on the part of a store to maintain customer's loyalty intention will determine whether or not customers continue purchasing and purchase frequently as well as cross-buy in specific in-store kiosks. H4a, H4b, H4c were supported.

It was also determined that computer anxiety negatively impacts the relationship between perceived complementarity and perceived relationship investment. This is because customers with computer anxiety have an anchor on their cognition (Tversky & Kahneman, 1974) to E-businesses. Even if the convenience store offers merchandise variety in the in-store kiosk, the customers with computer anxiety will still refusing to use information technology for the purpose of purchasing. Meanwhile, customers who have computer anxiety who think that using in-store kiosk in convenience store for purchasing is a kind of computer manipulating purchasing mechanism will also experience an anchoring effect (Tversky, & Kahneman, 1974). Even if the convenience store provides good quality in-store kiosk service or novel purchasing experiences, it was found that it is hard to diminish anxiety related to the use of an in-store kiosk. Hence, H5a, H5b, H5c were not supported.

In fact, the starting point of in-store kiosk design is the provision of efficient purchasing (Chiu et al., 2010) Hence, efficient purchasing is an appropriate strategy for customers who view time as a resource. Indeed, this study found that the convenience store developing in-store kiosk businesses are making an effort to provide efficient shopping in order to maintain loyal customers. These businesses usually solicit customers who have time

consciousness. Ultimately, relationship performance will go along with this effort. Hence, H6a, H6b, H6c were supported.

Theoretical Implications

Blau (1964) argued that businesses that provide benefits to customers will determine these customers' future behavior. Further, Kim and Son (2010) argued that when online businesses launch dedication-based relationship mechanisms, this will directly impact online user loyalty. Therefore, in-store kiosk business in convenience store launches dedication-based relationship mechanism strategy was not all affecting to the customer commit with their relationship with an in-store kiosk in convenience store. On the contrary, the dedication-based relationship maintenance mechanism should tie into the business relationship building effort. In other words, convenience stores that launch in-store kiosk businesses are not only providing benefits to customers but also are making an effort to evoke perceptions that the businesses are truly investing their resources to maintain customer loyalty. Relationship performance related to loyalty will in turn, be a result.

Meanwhile, this study found that computer anxiety negatively plays a moderating role between perceived complementarity of dedication-based relationship maintenance mechanisms and customer perceived relationship investments. Therefore, the anchoring effect from customers who have computer anxiety will serve as a notice for businesses willing to launch physical e-businesses in the situation of purely in-store kiosk transaction in convenience store (Tversky, & Kahneman, 1974). Hence, the dedication-based relationship maintenance mechanism has limitations that are a result of computer anxiety on the part of customers.

Finally, De Wulf et al. (2010) found that businesses who focus relationship investment in relationship building will determine customer loyalty. In fact, this study found that time consciousness acts as a moderator between relationships. Hence, customers who think of time as a resource escalate the effect between their perceptions that a business has invested effort in relationship building and the development of customer loyalty.

Managerial Implications

We found that the businesses that launch in-store kiosk businesses determine customer perceptions of relationship investment. Hence, convenience stores that are willing to

continually launch in-store kiosk businesses should tie in their relationship marketing strategy. Indeed, provision of merchandise variety, quality service and novel purchasing experiences to customers should be based on relationship marketing strategy. This will help in-store kiosks attract more loyal customers. Meanwhile, the business will earn long-term relationship benefits through relationship building strategies.

Further, this study found that customers with computer anxiety have an anchor to the use of technology. Hence, this study suggests that businesses that are willing to launch e-businesses should set strategy (e.g., on trial) designed to escalate customer experience in regard to the use of technology (Kim & Forsythe, 2008) Consequently, the habit of using technology will be gradually generated (Venkatesh, Thong, & Xu, 2012). This strategy will help the population of users who have computer anxiety. Finally, it will help e-businesses to become smoothly set into action in the future.

Finally, convenience stores that launch in-store kiosk businesses should continually develop efficacy purchasing process and functional relationship marketing strategy. This will benefit the in-store kiosk businesses ability to gain long-term benefits from relationship building with customers, especially the customers with time consciousness.

REFERENCES

1. Bagozzi, R.P., and Yi, Y. (1988), “On the evaluation of structural equation models”, Journal of the Academy of Marketing Science, Vol.16 No.1, pp.74-94.
2. Blau, P.M. (1964), “Exchange and power in social life”, Wiley, New York, NY.
3. Bloom, P.N., Gundlach, G.T., and Cannon, J.P. (2000), “Slotting allowances and fees: Schools of thought and the views of practicing managers”, Journal of Marketing, Vol.64 No.2, pp.92-108.
4. Bolton, R.N., Lemon, K.N., and Verhoef, P.C. (2004), “The theoretical underpinnings of customer asset management: A framework and propositions for future research”, Journal of the Academy of Marketing Science, Vol.32 No.3, pp. 271–292.
5. Cambre, M. A., and Cook, D. L. (1985), “Computer anxiety: Definitions, measurement, and correlates”, Journal of Educational Computing Research, Vol.1 No.1, pp.37–54.
6. Compeau, D.R., and Higgins, C.A. (1995), “Computer self-efficacy: Development of a measure and initial test”, MIS Quarterly, Vol.19 No.2, pp.189-211.
7. Collier, J.E., and Sherrell, D.L. (2010), “Examining the influence of control and convenience in a self-service setting”, Journal of the Academy Marketing Science, Vol.38 No.4, pp.490-509.

8. Chiu, T.T.H., Fang, S.C., and. Tseng, C.C. (2010), "Early versus potential adopters: Exploring the antecedents of use intention in the context of retail service innovations", International Journal of Retail & Distribution Management, Vol.38 No.6, pp.443-459.
9. Crosby, L.A., Evans, K.A., and Cowles, D. (1990), "Relationship quality in services selling: An interpersonal influence perspective", Journal of Marketing, Vol.54 No.3, pp.68–81.
10. De Wulf, K., Odekerken-Schrod, G., and lacobucci, D. (2001), "Investments in consumer relationships: A cross-country and cross-industry exploration", Journal of Marketing, Vol. 65 No.4, pp.33-50.
11. Delone, W.H., and McLean, E.R. (2004), "Measuring e-commerce success: Applying the information systems success model", International Journal of Electronic Commerce, Vol.9 No.1, pp.31-47.
12. Elie-dit-cosaque, C., Pallud, J., and Kalika, M. (2011), "The influence of individual, contextual, and social factors on perceived behavioral control of information technology: A field theory approach", Journal of Management Information Systems, Vol.28 No.3, pp.201-234.
13. Gutierrez, S.S.M., Izquierdo, C.C., and Cabezudo, R.S.J. (2010), "Product and channel-related risk and involvement in online contexts", Electronic Commerce Research & Applications, Vol.9 No.3 pp.263-273.
14. Hackbarth, G., Grover, V., and Yi, M.Y. (2003), "Computer playfulness and anxiety: positive and negative mediators of the system experience effect on perceived ease of use", Information & Management, Vol.40 No.3, pp.221-232.
15. Huppertz, J. W., Arenson, S. J., and Evans, R. H. (1978), "An application of equity theory to buyer-seller exchange situations", Journal of Marketing Research, Vol.15 No.2, pp.250-260.
16. Katz, M.L., and Shapiro, C. (1985), "Network externalities, competition, and compatibility", American Economic Review, Vol.75 No.3, pp. 424–440.
17. Kim, J., and Forsythe, S. (2008), "Adoption of virtual try-on technology for online apparel shopping", Journal of Interactive Marketing, Vol.22 No.2, pp.45-59.
18. Kim, S.S., and Son, J.Y. (2009), "Out of dedication or constraint? A dual model of post-adoption phenomena and its empirical test in the context of online services", MIS Quarterly, Vol.33 No.1, pp.49-70.
19. Kleijnen, M., De Ruyter, K., and Wetzels, M. (2007), "An assessment of value creation in mobile service delivery and the moderating role of time consciousness", Journal of Retailing, Vol.83 No.1, pp.33-46.
20. Kotler, P., and Keller, K. (2010), "A Framework for Marketing Management (5th ed)", Prentice Hall, New Jersey, NJ.

21. Levitt, T., 1960. Marketing myopia, Harvard Business Review.38(4): 57–66.
22. Liang, C.J., and Chen, H.J. (2009), "A study of the impacts of website quality on customer relationship performance", Total Quality Management and Business Excellence, Vol.20 No.9, pp.971-988.
23. Lin, J.S.C., and Hsieh, P.L. (2011), "Assessing the self-service technology encounters: Development and validation of SSTQUAL scale", Journal of Retailing, Vol.87 No.2, pp.194-206.
24. Meuter, M.L., Ostrom, A.L., Roundtree, R.I., and Bitner, M.J. (2000), "Self-service technologies: Understanding customer satisfaction with technology-based service encounters", Journal of Marketing, Vol.64 No.3, pp.50-65.
25. Oliver, R. L. (1999), "Whence consumer loyalty?", Journal of Marketing, Vol.63 No.4, pp.33-44.
26. Ostlund, L.E. (1974), "Perceived innovation attributes as predictors of innovativeness", Journal of Consumer Research, Vol.1 No.2, pp.23-29.
27. Ou, C.S., Hung, S.Y., Yen, C.D., and Liu, F.C. (2009), "Impact of ATM intensity on cost efficiency: An empirical evaluation in Taiwan", Information & Management, Vol.46 No.8, pp.442-447.
28. Podsakoff, P. M., MacKenzie, S. B., Lee, J.Y., and Podsakoff, N. P. (2003), "Common method biases in behavioral research: A critical review of the literature and recommended remedies", Journal of Applied Psychology, Vol.88 No.5, pp.879-903.
29. Rogers, E. M. (1983), "Diffusion of Innovations (3rd.Ed.)", Free Press, New York, NY.
30. Saeed, K.A., and Abdinnour-Helm, S. (2008), "Examining the effects of information system characteristics and perceived usefulness on post adoption usage of information systems", Information & Management, Vol.45 No.6, pp.376-386.
31. Tversky, A., and Kahneman, D. (1974), "Judgment under uncertainty: Heuristics and biases", Science, Vol.185 No.4157, pp.1124-31.
32. Verhoef, P.C. (2003), "Understanding the effect of customer relationship management effects on customer retention and customer share development", Journal of Marketing, Vol.67 No.4, pp.30-45.
33. Venkatesh, V., Thong, J.Y.L., and Xu, X. (2012), "Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology", MIS Quarterly, Vol.36 No.1, pp.157-178.
34. Wells, J.D., Campbell, D.E., Valacich, J.S., and Featherman, M. (2010), "The effect of perceived novelty on the adoption of information technology innovations: A risk/reward perspective", Decision Science, Vol.41 No.4, No.813-843.
35. Weise, G. (1975), "Psychologische Leistungstests", Hogrefe, Göttingen, GO.
36. Yang, Z., Cai, S., Zhou, Z., and Zhou, N. (2005), "Development and validation of an

instrument to measure user perceived service quality of information presenting web portals", Information & Management, Vol.42 No.4, pp.575-589.

37. Zhang, Y., Fang, Y., Wei, K., Ramsey, E., McCole, P., and Chen, H. (2011), "Repurchase intention in B2C e-commerce—A relationship quality perspective", Information & Management, Vol.48 No.6, pp.192-200.
38. Zhu, Z., Nakata, C., Sivakumar, K., and Grewal, D. (2007), "Self-service technology effectiveness: The role of design features and individual traits", Journal of the Academy of Marketing Science, Vol.35 No.4, pp.492-506.
39. Zhou, T., and Lu, Y. (2011), "Examining mobile instant messaging user loyalty from the perspectives of network externalities and flow experience", Computers in Human Behaviour, Vol.27 No.2, pp.883-889.

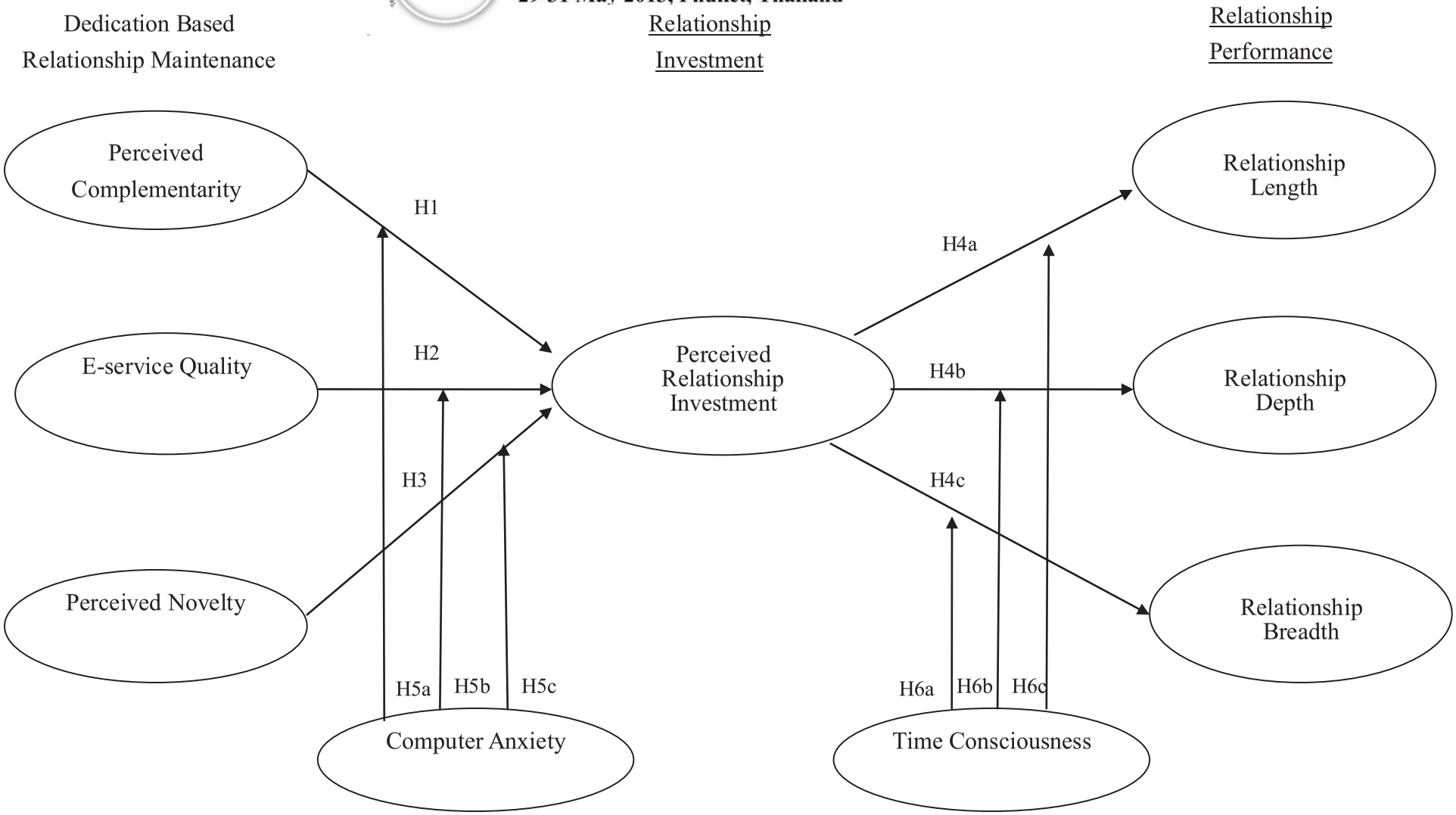


Figure 1 The conceptual framework

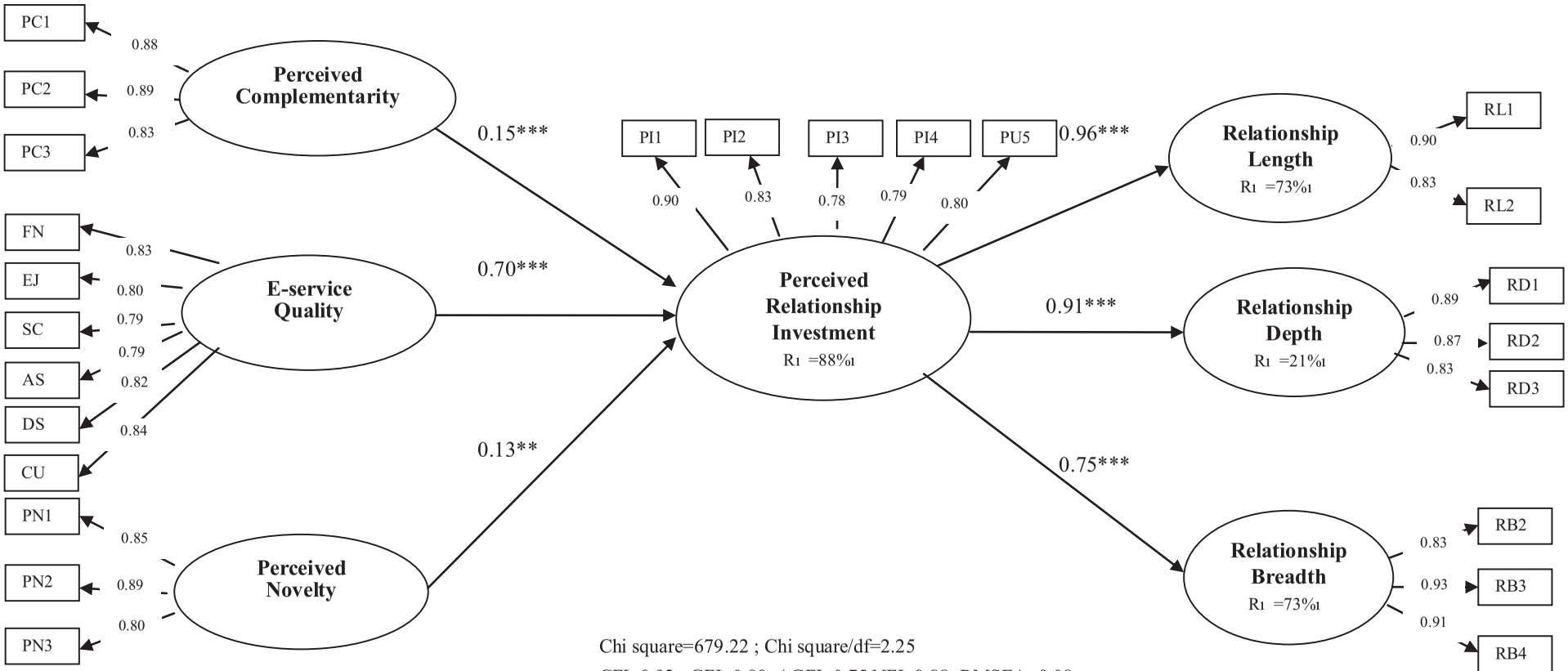


Figure 2 Results of structural equation modeling

Table 1 Sample demographic (N= 211)

Measure	Items	Frequency (%)	
Gender	Male	101	(47.90)
	Female	110	(52.10)
Age	Under 20	9	(4.30)
	21-24	76	(36.00)
	25-29	73	(34.60)
	30-34	45	(24.30)
	35-39	4	(1.90)
	>40	4	(1.90)
Education	Under High School	1	(5.00)
	High School	5	(2.40)
	University	123	(58.30)
	Graduate School	82	(38.90)
Disposable income($USD/per month)	Lower than $500	94	(44.50)
	$501-$1000	27	(12.80)
	$1001-$2,000	42	(19.91)
	$2,001-$2,500	28	(13.30)
	>$2,501	20	(9.50)
Occupation	Public sector	32	(15.20)
	Private sector	78	(37.00)
	Housewife	4	(1.90)
	Student	89	(42.20)
	Others	8	(3.80)
How many times do you usually shop through in-store kiosk?	<1	109	(51.70)
	2	65	(30.80)
	3	23	(10.90)
	4	8	(3.79)
	>5	6	(2.84)
In which in-store kiosk in convenience store do you usually purchase?	i-bon(7-11)	191	(90.50)
	Famiport(Family Mart)	110	(7.10)
	LifeET(HiLife)	5	(2.40)

Table 2 Discriminate validity

Constructs	PC	SQ	PN	PI	TC	CA	RL	RD	RB
PC	**0.87**$^{+}$								
SQ	0.55**	**0.81**$^{+}$							
PN	0.52**	0.76**	**0.85**$^{+}$						
PI	0.56**	0.76**	0.71**	**0.82**$^{+}$					
TC	0.29**	0.46**	0.28**	0.37**	**0.80**$^{+}$				
CA	-0.26**	0.02**	0.02**	-0.08**	0.04**	**0.84**$^{+}$			
RL	-0.30**	0.60**	0.51**	0.49**	0.43**	0.17**	**0.90**$^{+}$		
RD	0.06**	0.49**	0.35**	0.30**	0.32**	0.38**	0.69**	**0.86**$^{+}$	
RB	0.45**	0.76**	0.63**	0.67**	0.38**	0.06**	0.64**	0.53**	**0.91**$^{+}$

Note 1: PC=Perceived complementarity; SQ= e-service quality; PN= Perceived novelty; TC= Time consciousness; CA= Computer anxiety; RL=Relationship length; RD= Relationship Depth; RB=Relationship breadth

Note 2: $^{+}$ = Square Root of Average Variance Extracted (AVE)

Note 3: **correlation is significant at the 0.01 level (two-tailed).

Table 3 The results of the structural equation model

	Hypothesized relationship	β	t-value	Conclusion
H1	Perceived Complementarity → Perceived Relationship Investment	0.15***	2.85	Supported
H2	e-service Quality → Perceived Relationship Investment	0.70***	7.07	Supported
H3	Perceived Novelty → Perceived Relationship Investment	0.13**	2.41	Supported
H4a	Perceived Relationship Investment → Relationship Length	0.96***	8.82	Supported
H4b	Perceived Relationship Investment → Relationship Depth	0.91***	5.90	Supported
H4c	Perceived Relationship Investment → Relationship Breadth	0.75***	4.99	Supported
Perceived Complementarity → Relationship Length		-0.22	-1.87	Insignificant
Perceived Complementarity → Relationship Depth		-0.26**	-2.27	Negative Significant
Perceived Complementarity → Relationship Breadth		-0.10	-1.80	Insignificant

Note: ***P<0.001; **P<0.01

Fit Index: Chi square=679.22; Chi square/df=2.25; CFI=0.92; GFI=0.80; AGFI=0.75 NFI=0.88; RMSEA=0.08

Table 4 Hierarchical regression between dedication-based relationship maintenance mechanism and perceived relationship investment (Computer Anxiety)

Dependent variable: Perceived Relationship Investment																		
	Step 1		Step 2		Step 3		Step 1		Step 2		Step 3		Step 1		Step 2		Step 3	
Independent Variables	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value
Perceived Complementarity	0.62***	9.87	0.64***	9.86	0.69***	10.15												
e-service Quality							0.76***	7.58	7.65***	17.00	0.77***	16.93						
Perceived Novelty													0.62***	14.57	0.57***	13.34	0.57***	13.30
Computer Anxiety			0.05	1.20	0.05***	10.17			-0.06***	-2.03	0.06	-1.91			0.06	-0.06	0.16***	3.84
Interaction																		
Perceived Complementarity * Computer Anxiety					-0.10***	-2.22												
e-service Quality* Computer											-0.01	0.76						

Dependent variable: Perceived Relationship Investment																
	Step 1		Step 2		Step 3		Step 1		Step 2		Step 3		Step 1		Step 2		Step 3	
Anxiety																		
Perceived Novelty* Computer Anxiety																	-0.01	-0.57
R2	0.56		0.57		0.58		0.58		0.58		0.58		0.50		0.54		0.53	
Adjusted R2	0.32		0.32		0.33		0.57		0.58		0.58		0.50		0.53		0.53	
ΔR2	0.32		0.05		0.02		0.06		0.58		0.00		0.50		0.03		0.00	
VIF	1.00		(1.07~1.07)		(1.08~1.18)		1.00		(1.00~1.00)		(1.00~1.05)		1.00		(1.08~1.08)		(1.01~1.10)	

Note: ***P<0.001; **P<0.05

Table 5 Hierarchical regression between perceived relationship investment and relationship performance (Time Consciousness)

	Dependent variable: Relationship Length						**Dependent variable**: Relationship Depth						**Dependent variable**: Relationship Breadth					
	Step 1		Step 2		Step 3		Step 1		Step 2		Step 3		Step 1		Step 2		Step 3	
Independent Variables	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value	β	t-value
Perceived Relationship Investment	0.61***	8.12	0.47***	6.16	0.49***	4.40	0.48***	4.54	0.34***	6.16	0.36***	3.46	0.77***	12.90	0.70***	11.11	0.71***	11.42
Time Consciousness			0.30***	4.64	0.28***	6.39			0.34**	4.64	0.28***	3.21			0.15**	2.83	0.13***	2.56
Interaction																		
Perceived Relationship Investment * Time Consciousness					0.19***	2.93					0.44***	5.50					0.13***	2.87
R2	0.24		0.31		0.34		0.09		0.14		0.25		0.44		0.46		0.48	

	Dependent variable: Relationship Length			**Dependent variable**: Relationship Depth			**Dependent variable**: Relationship Breadth		
	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
Adjusted R2	0.24	0.30	0.33	0.09	0.13	0.24	0.44	0.46	0.48
ΔR2	0.24	0.07	0.03	0.09	0.05	0.11	0.44	0.02	0.02
VIF	1.00	(1.16~1.16)	(1.01~1.18)	1.00	(1.16~1.16)	(1.01~1.18)	1.00	(1.16~1.16)	(1.01~1.18)

Note: ***P<0.001; **P<0.05

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

ONLINE MEDIA EVALUATION OF DISASTER MANAGEMENT

**Panom Gunawong, Faculty of Political Science and Public Administration,
Chiang Mai University, Thailand
Email: panom.gunawong@cmu.ac.th**

**Jiratiwat Pongnaparuk, Faculty of Political Science and Public Administration,
Chiang Mai University, Thailand
Email: jiratiwat11@gmail.com**

ABSTRACT

Purpose *- Nowadays, natural disasters happen increasingly and create severe damage worldwide. Being prepared and responsive is of great necessity. Therefore, this study aimed to analyze the capacity and efficiency of the public sector in disaster management, especially regarding online media.*
Design/methodology/approach *- The National Disaster Warning Centre (NDWC) in Thailand was the online media selected as a case study. The website was measured by criteria of the W3C (World Wide Web Consortium). The concept of content analysis was used to analyze the information on Twitterand Facebook during the worst flooding ever in Thailand during October, 2011.*
Findings *- The online media in this study could be considered as a critical and useful tool for developing disaster management. However, the website concerned could not achieve the W3C standard, and Twitter could not interest people in society, due to its content. This fact is confirmed by Twitter having only 11,142 followers, while another NGO; #Thaiflood, had 107,680. Facebook faced the same problem as Twitter of drawing little attention or interaction from society.*
Practical implications - *There are large gapsin the development of online media in the public sector. All media should be improved to meet the required standard, and be considered a reliable source for disaster management.*
Originality/value - *Most e-government in Thailand, for example e-disaster, lacks evaluation of its capacity. This study provides and suggests insightful information for development. If the media could be improved, preparation for disaster would be better, and responses to it prompt.*

Keywords: Disaster management, eDisaster, Online media, Website, Facebook, Twitter

INTRODUCTION

During the past decade, the world has witnessed several natural disasters that took a number of lives and caused severe damages to the infrastructure and economy. For example, Hurricane Katrina, which hit the northern Gulf coast of the USA in August 2005, was 'the costliest and one of the five deadliest hurricanes to ever strike the United States', leaving 1,833 fatalities and estimated damage worth US$ 108 billion (Knabb*et al.*, 2005). Recently, the earthquake of March 2011 in Japan triggered a tsunami that caused 15,854 deaths and over US$ 200 billion worth of damage (as of March 2012) [I]. Also, Thailand suffered greatly from the tsunami in December 2004, which was described as 'the worst natural

disaster ever in Thailand' [II]. It killed 5,395 people and caused approximately US$ 365 million worth of damage in the country [III]. In 2011, Thailand also experienced its worst flooding in half a century, with 657 fatalities and estimated damage worth US$ $75 billion.

In response to such natural disasters, governments have employed information and communication technologies (ICTs) increasingly, in order to prepare well before disasters occur, or be more effective in responding to them and their aftermath. For instance, various early warning systems or simulation models have been developed for tsunamis (e.g. Harjadi 2008; Teh and Koh, 2011); while an attempt was made to use radio frequency identification (RFID) wireless network technology for emergency evacuation (Chatfield *et al*., 2010). Online media such as twitter and Facebook also have been used increasingly in emergency management (e.g. Murphy, 2013; Sakaki*et al*., 2010).

After facing the 2004 tsunami in Thailand, the Thai government established the National Disaster Warning Center (NDWC) in 2005, in order to provide the public with information and early warning of disasters. Like other government agencies involved in disaster management, the NDWC employs online media as one of its communication channels to disseminate disaster information. Its online media were used recently during the 2011 flood. This provided a great opportunity to explore online media for use in disaster management in the Thai public sector context. Therefore, this paper aimed to evaluate use of the NDWC website, twitter and Facebookduring the aforementioned disaster, andfocus on the period of October 2011 [IV].

RELATED WORK

Heeks (2008) stated thate-government is "the use of information and communication technologies (ICTs) to improve the activities of public sector organizations." Thus, government use of online media can be viewed as part of this e-government movement. Government agencies have relied increasingly not only on their websites, but also online media for disseminating information to the general public. For example, many state public health departments in the USA are using Facebook, twitter and You Tube (Thackeray et al., 2012), while use of online media by agencies concerned with fire services has been reported as well (Murphy, 2013).

In the context of disaster management, Lindsay (2011)outlined that online media can be employed by government agencies concerned with such issues as public safety information, emergency warnings, and requests for assistance. Apart from its use as channels of communication between the agencies concerned and general public, online media can be employed also as a tool for 'knowledge exchange between crisis management experts' during an emergency (White, 2012). Although online media have gained currency in disaster management, Keim and Noji (2011) pointed out that its use in this context still faces some challenges such as accessibility compared to traditional media, potential to spread misinformation and rumor, and risk of privacy rights violation. Furthermore, issues like security of information, robustness of the system (e.g. reliability), and overreliance on online media also pose concerns (White, 2012).

In relation to the above work, online media seem to have both advantage and disadvantage, asthe system depends on the provider, user and situation. However, more room still exists to

investigate the influence of online media in disaster management. For a developing country such as Thailand, this study intended to ask the question, 'How does the public sector apply efficient online media for disaster management?'

RESEARCH METHODOLOGY

The data for this study were collected in October 2011 from the NDWC website (www.ndwc.go.th) as well as its twitter and Facebook. The providedInformationand design of the website were evaluated accordingto World Wide Web Consortium (W3C) standards by using the websites:www.validator.w3.org and www.jigsaw.w3.org/css-validator/validator.html.en.The criteria for regulatingaccess to public ICTs for disabled peoplewere shown accordingto ministerial regulations issued in 2011 by using the website:www.thaiwebacessibility.com.

Regarding NDWC twitter and Facebook, the data comprised tweets derived from #NDWC_Thai and messages posted on NDWC Facebook. In total, there were 358 tweets and 59 messages. The data collected were analyzed by means of content analysis. The number of re-tweets, favorites, and replies from each tweet was counted daily. All tweets were categorized into seven groups based on the disaster information provided, which included, 1) preparedness for flood, 2) evacuation warnings, 3) information on natural disasters occurring in Thailand, 4) information on how to follow flood situations, 5) flood relief (requests for relief or information on where to obtain it), 6) information on how to contribute to flood relief, and 7) information unrelated to flood. The sources of information from tweets were classified into nine groups, including online radio stations, online news agencies, online newspapers, the general public, government agencies/NGOs, NDWC, academics/experts, reporters, and others.

Similarly, the number of Likes, Comments and Shares were counted on each NDWC Facebook message. The Facebook messages also were categorized into groups, based on the disaster information they disseminated, including 1) preparedness for flood, 2) information on natural disasters occurring in Thailand, 3) flood relief (requests for relief or information on where to obtain it), 4) requests for information on flood situations, and 5) information unrelated to flood. The sources of messages posted on Facebook were classified into different groups, as with those of tweets.

RESULTS AND DISCUSSION

1. Analysis of the NDWC website

Website design and the information provided on the NWDC website were analyzed according to W3C standards; and the criteria set by ministerial regulations on access to public ICTs for disabled people were shown using standard evaluation websites, as mentioned in section 3. Evidently, the NDWC did not meet W3Cstandards and the criteria stipulated in ministerial regulations were found wanting. For example, 176 errors and 43 warnings were found when testing for 'Markup Validation Service' in the W3C standard (Figure 4.1). Regarding accessibility of ICTs for disabled people, the evaluation found 82 problems on accessibility, 254 items causing incomplete access, and 709 items that would improve accessibility (Figure 4.2). The substandard NDWC website apparently caused difficulties for online media users

trying to follow its information.For instance, the web links provided could not be accessed, and some online media users, particularly disabled people, could not utilize disaster information fullybecause the website was not user-friendly for them.

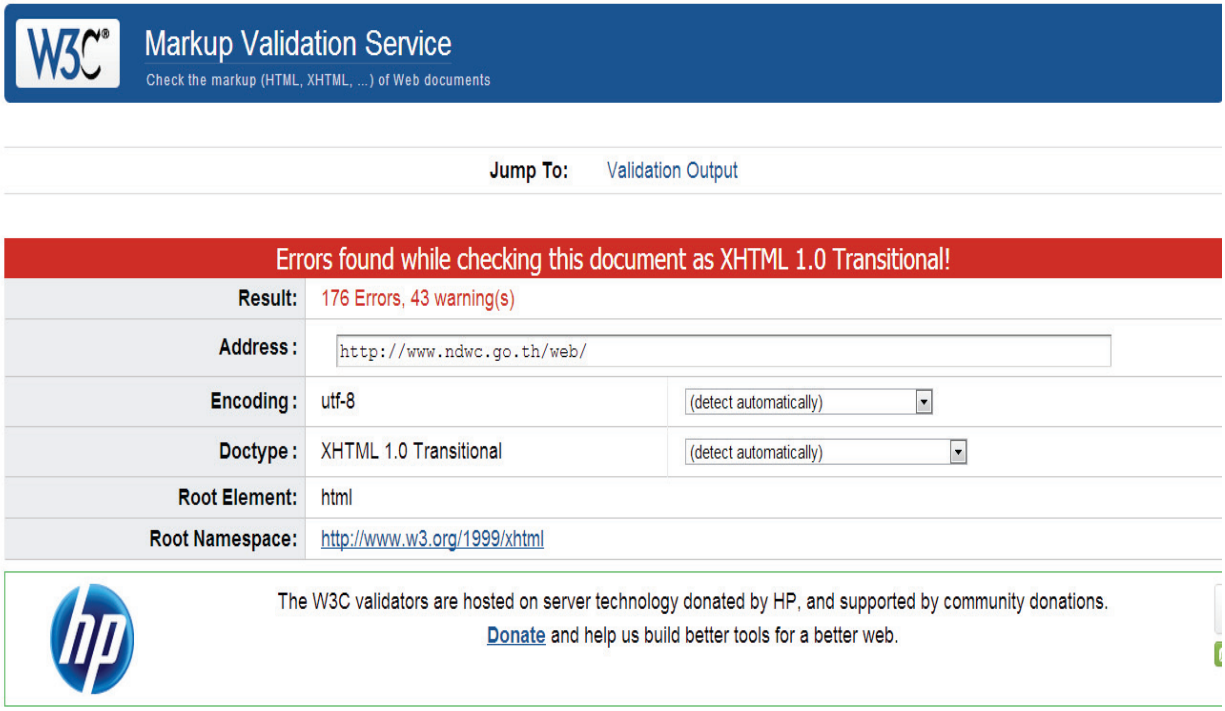


Figure 4.1 Results of NDWC website evaluation regarding the Markup Validation Service.

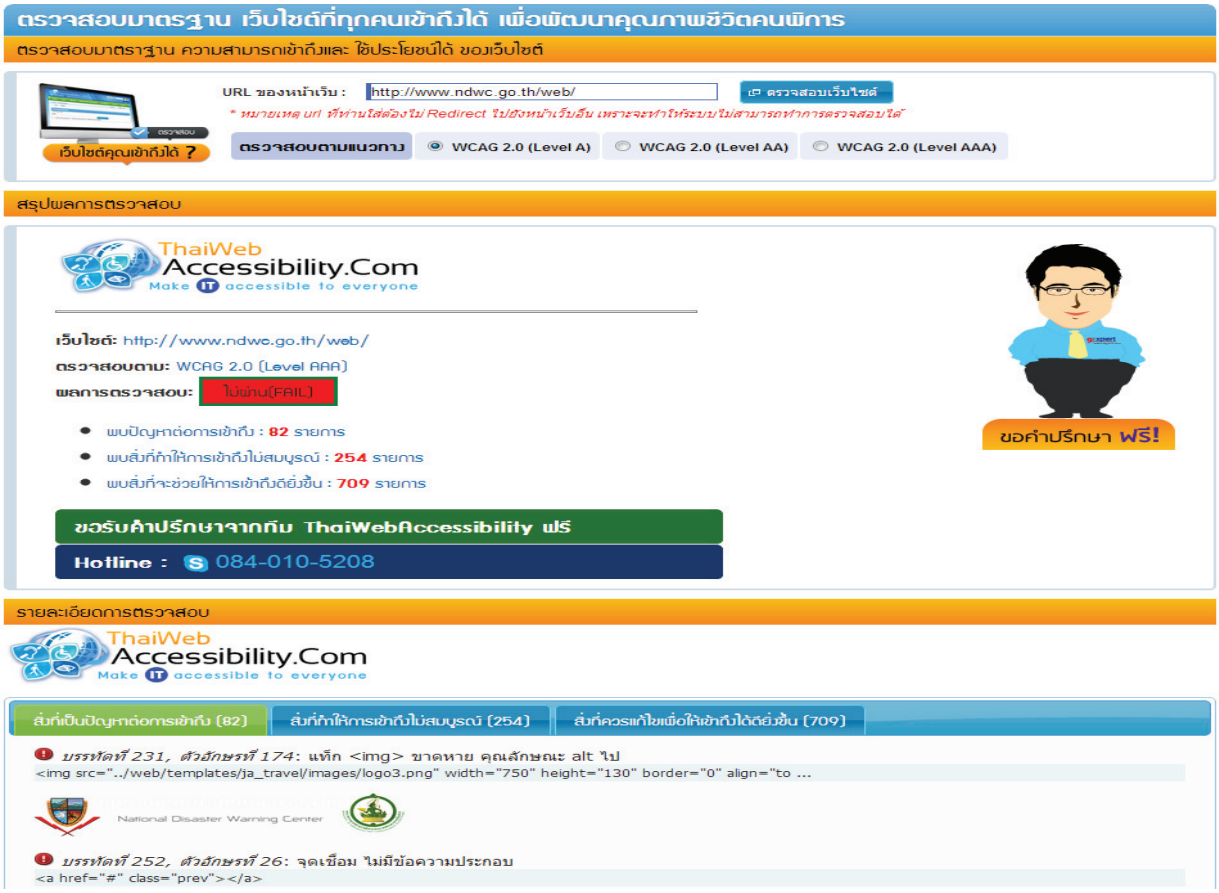


Figure 4.2 Results of NDWC website evaluation regarding the disabled people's accessibility by Thaiwebacessibility website

2 Analysis of NDWC twitter

In October 2011, NDWC twitter was monitored together with hash tag#NDWC_Thai. It was found that NDWC twitter was active for only 11 days during that month, with 11,142 followers. In total, there were 358 tweets, with 121,267 re-tweets, 640 favorites and 16 replies (Table 4.1). On average, there were only 32 tweets and 1,106 re-tweets/day. Apparently, the NDWC attracted very little attention from outsiders. This was confirmed by the fact that twitters fromhash tag #Thaiflood, an NGO working on floods, had 107,680 followers, while NDWC had only 11, 142. Notwithstanding, it could be seen that collected tweets generated a rather high number of re-tweets. Thus, the NDWC twitter may be less active overall.

Table 4.1 NDWC tweets in October 2011

Date	Tweet	Re-tweet	Favorite	Reply
3 October 2011	8	1	0	0
10 October 2011	55	1,145	43	5
11 October 2011	64	2,051	70	3
12 October 2011	63	2,719	54	2
13 October 2011	35	869	39	2

Date	Tweet	Re-tweet	Favorite	Reply
14 October 2011	17	255	26	2
15 October 2011	56	2,404	324	1
18 October 2011	29	901	34	1
19 October 2011	10	1,034	30	0
20 October 2011	12	249	5	0
21 October 2011	9	539	12	0
Total	**358**	**12,167**	**640**	**16**
Average/Day	**32**	**1,106**	**58**	**2**

The contents of NDWC tweets were concerned mostly with flood and flood relief, accounting for 150 and 96 tweets, respectively (Table 4.2). A relatively small number of tweets dealt with flood preparedness (28 tweets), channels for making contributions to flood relief (22 tweets),following the flood situation (22 tweets), and evacuation announcements (5 tweets). The rest contained information unrelated to flood. Despite the small number of tweets, they still covered important corresponding issues that phased in with the disaster management cycle (Carter, 1992). That is to say, tweets providing information on a flood situation, channels to follow it and preparedness for a flood can be considered as phases of *prevention, mitigation and preparedness*, while tweets on flood relief, evacuation announcements, and channels for making contributions to flood relief are in the *response* phase.

Table 4.2 Types of NDWC tweets

Date	Types of Tweets						
	PD	**EV**	**FS**	**CFS**	**FR**	**CCF**	**OT**
3 October 11	5	0	0	0	0	0	3
10 October 11	5	2	22	2	15	5	4
11 October 11	5	1	18	11	15	7	7
12 October 11	6	0	35	5	8	3	6
13 October 11	1	2	22	1	5	1	3
14 October 11	1	0	9	1	4	0	2
15 October 11	1	0	13	0	32	4	6
18 October 11	2	0	14	1	10	1	1
19 October 11	1	0	4	1	2	1	1
20 October 11	0	0	7	0	5	0	0
21 October 11	1	0	6	0	0	0	2
Total	**28**	**5**	**150**	**22**	**96**	**22**	**35**
Average/Day	**2**	**0.4**	**13**	**2**	**8**	**2**	**3**

Note: PD – Preparedness, EV – Evacuation, FS – Flood Situation, CF – Channel to Follow Flood Situations, FR – Flood Relief, CCF – Channel for MakingContributions to Flood Relief, and OT - Others

The last aspect regarded the source of information from tweets inhash tag #NDWC Thai, and not surprisingly, it was found that most of the messages tweeted were from the NDWC, which accounted for 92 tweets, followed by reporters and government agencies/NGOs, with 60 and 52 tweets, respectively. It should be noted that sources of information from public

figures (e.g. movie stars and signatories, classified under the 'others' groups) accounted for only 10 tweets, but their chances of being re-tweeted were far greater than those of the NDWC and government agencies/NGOs, due to public status.

Table 4.3 Sources of information from NDWC twitter

Date	Sources of information								
	RD	NP	GO/ NGO	GP	EX	NDWC	NS/ TV	RP	OT
3 October 11	0	0	0	0	0	8	0	0	0
10 October 11	1	1	5	10	1	18	9	8	2
11 October 11	2	6	12	9	6	11	10	7	1
12 October 11	4	6	10	5	4	12	8	13	1
13 October 11	2	2	6	2	2	1	5	13	2
14 October 11	2	0	3	0	1	4	3	4	0
15 October 11	1	2	8	3	6	25	4	4	3
18 October 11	2	3	4	3	1	7	4	4	1
19 October 11	0	1	1	2	0	0	3	3	0
20 October 11	0	0	1	1	1	6	2	1	0
21 October 11	0	0	2	0	1	0	3	3	0
Total	**14**	**21**	**52**	**35**	**23**	**92**	**51**	**60**	**10**
Average/Day	**1**	**1**	**4**	**3**	**2**	**8**	**4**	**5**	**0.9**

Note: RD – Radio Stations, NP – Newspapers, GO/NGO – Government Agencies/NGOs, GP – General Public, EX – Experts, NDWC – National Disaster Warning Center, NS – News Agencies/ Television Stations, RP – Reporters, and OT - Others

3 Analysis of NDWC Facebook messages

In October 2011, NDWC Facebook was found to have 19 messages posted on Facebook studies during the course of seven separate days (Table 4.4), with 2,474 followers. Reactions to the comments posted were 149 Likes and 83 Shares. Clearly, the NDWC attracted little attention from the others group. The fact that Thaiflood Facebook and NDWC Facebook had 67, 937 and a mere 2,474 followers, respectively, helped to paint a clear perspective. When considering that 16 messages from a total of 19 were posted by the NDWC itself (Table 4.5), Facebook interaction in this regard was even more marginal, with one message each from an online newspaper, government agency/NGO, and the general public.

Table 4.4 NDWC Facebook messages in October 2011

Date	Number of Messages	Number of Likes	Number of Shares	Number of Comments
5 October 2011	1	8	-	1
7 October 2011	4	41	34	7
11 October 2011	4	9	13	13
12 October 2011	6	47	6	32
13 October 2011	2	24	1	2

Date	Number of Messages	Number of Likes	Number of Shares	Number of Comments
18 October 2011	2	11	24	5
24 October 2011	3	9	5	1
Total	**19**	**149**	**83**	**61**

Table 4.5 Users posting messages on NDWC Facebook

Date	Source of Information							
	RD	NP	GO/ NGO	GP	EX	NDWC	NS/TV	OT
5 October 11	-	1	-	-	-	-	-	-
7 October 11	-	-	1	-	-	3	-	-
11 October 11	-	-	-	-	-	1	-	-
12 October 11	-	-	-	1	-	5	-	-
13 October 11	-	-	-	-	-	2	-	-
18 October 11	-	-	-	-	-	2	-	-
24 October 11	-	-	-	-	-	3	-	-
Total	**-**	**1**	**1**	**1**	**-**	**16**	**-**	**-**

Note: RD – Online Radio Stations, NP – Online Newspapers, GO/NGO – Government Agencies/NGOs, GP – General Public, EX – Experts, NDWC – National Disaster Warning Center, NS – Online News Agencies/ Television Stations, and OT – Others

When looking into the contents of messages posted, most messages (11 messages, see Table 4.6) were categorized as others, which referred to 'other information unrelated to flood' (see section 2), while seven messages dealt with flood situations and one with preparedness for a flood. Evidently, NDWC Facebook achieved very little in providing flood information.

Table 4.6 Types of Comments on NDWC Facebook messages

Date	Types of Messages					
	PD	EV	FS	RI	OT	Total
5 October 11	-	-	1	-	-	1
7 October 11	-	-	3	-	1	4
11 October 11	-	-	1	-	-	1
12 October 11	1	-	2	-	3	6
13 October 11	-	-	-	-	2	2
18 October 11	-	-	-	-	2	2
24 October 11	-	-	-	-	3	3
Total	**1**	**-**	**7**	**-**	**11**	**19**

Note: PD – Preparedness, EV – Evacuation, FS – Flood Situation, RI – Request for Information, and OT – Others

CONCLUSION

With the number of online media users continuing to rise, together with continual development of related technologies (e.g. internet network and new applications), the potential use of new channels to disseminate information as part of disaster management also increases. However, the capacity to use these channels effectively, particularly by the public sector, needs to be evaluated. As illustrated by the NDWC, a large gap needs to be filled in order to improve the use of online media by government agencies. In turn, this would improve disaster management, and thus enhance preparedness for and responses to disasters. Ultimately, loss of life and damage to infrastructure and the economy would be minimized.

REFERENCES

1. Carter, W. N. (1992), Disaster Management: A disaster Managers' Handbook, Asian Development Bank, Manila.
2. Chatfield, A.., FossoWamba, S., and Hirokazu, T. (2010), "E-Government Challenge in Disaster Evacuation Response: The Role of RFID Technology in Building Safe and Secure Local Communities" Paper presented at 43 Hawaii International Conference on System Sciences (HICSS), Electronic Government, Emerging Topics, in Koloa, Kauai, Hawaii, USA.
3. Harjadi, P. J. P. (2008), "Indonesia Tsunami Early Warning System (InTEWS): Concept and Implementation", Paper presented at International Workshop on Post Tsunami Soil Management, 1-2 July 2008 in Bogor, Indonesia.
4. Heeks, R. (2008), "What is eGovernment?", available at: http://www.egov4dev.org/success/definitions.shtml (accessed 9 April 2013).
5. Keim, M. E., and Noji, E. (2011)."Emergent use of social media: a new age of opportunity for disaster resilience", American Journal of Disaster Medicine, Vol. 6 No.1, pp. 47-54.
6. Knabb, R. D., Rhome, J. R., and Brown, D. P. (2005), "Hurricane Katrina, 23-30 August 2005", Tropical Cyclone Report, National Hurricane Center, Florida, USA, 20 December 2005 (Updated 10 August 2006 and 14 September 2011).
7. Lindsay, B. R. (2011), "Social media and disasters: current uses, future options, and policy considerations". CRS Report for Congress prepared for Members and Committees of Congress, Congressional Research Service, 6 September 2011. Available at: www.fas.org/sgp/crs/homesec/R41987.pdf
8. Murphy, M. (2013), "Social Media and the Fire Service.",Fire Technology, Vol. 49 No 1, pp. 175-183.
9. Sakaki, T., Okazaki, M., and Matsuo, Y. (2010), "Earthquake Shakes Twitter Users: Real-time Event Detection by Social Sensors" in WWW 10 Proceedings of the 19th International Conference on World Wide Web, Raleigh, North Carolina, USA, 26-30 April 2010, pp.851-860.
10. Teh, S. Y., and Koh, H. L. (2011), "Tsunami Simulation for Capacity Development", in the Proceedings of the International MultiConference of Engineers and Computer Scientists 2011, Vol. II, 16-18 March 2011 in Hong Kong.
11. Thackeray, R., Neiger, B. L., Smith, A. K., and vanWagenen, S. B. (2012), "Adoption and use of social media among public health departments", BMC Public Health, Vol. 12 (article no. 242).

12. White, C. M. (2012), Social Media, Crisis Communication, and Emergency Management: Leveraging Web 2.0 Technologies, CRC Press, Boca Ration, FL.

Note

1. [I] http://www.ngdc.noaa.gov/hazard/honshu_11mar2011.shtml (accessed 10 April 2013)
2. [II] http://www.un.or.th/tsunamiinthailand/Tsunami2004anditsimpact.html (accessed 10 April 2013)
3. [III] http://www.un.or.th/pdf/ddpm_tsunami.pdf (accessed 10 April 2013)
4. [IV] http://www.thaiwater.net/web/attachment/379_thailandflood_es_v2.pdf (accessed 10 April 2013)

Authors:
PanomGunawong* is a lecturer in the Faculty of Political Science and Public Administration at ChiangMaiUniversity, Chiang Mai, Thailand. Dr. Gunawong holds a Ph.D. in Development Policy and Management from the University of Manchester, UK. His core areas of focus are e-governance, e-government, ICT4D and failure analysis.

JiratiwatPongnaparukis a student in the Faculty of Political Science and Public Administration at ChiangMaiUniversity, Chiang Mai, Thailand. She is interested in e-government and social media use for enhancing public services.

* Corresponding author: Fax +66 53 942988
E-mail address: panom.gunawong@cmu.ac.th (P. Gunawong).
Address: Faculty of Political Science and Public Administration,
ChiangMaiUniversity, Chiang Mai50200, Thailand

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE ANTECEDENTS OF INNOVATION CLIMATE: CROSS-LEVEL MEDIATION PERSPECTIVES

Li-Yueh Lee, Kun Shan University, Taiwan
Email: wuleliyu@gmail.com

Veasna Sou,Institute of International Management, National Cheng Kung University, Taiwan
Email: souveasna76@yahoo.com

ABSTRACT

Purpose: *This study aims to examine the significance of person-organizational fit on innovation climate through a mechanism of the cross-level mediation effects of emotional intelligence and psychological climate. The moderating effect of leader openness on the relationship between emotional intelligence and psychological safety is also examined in this study.*
Design/methodology/approach: *First, a random sampling technique was adopted to select 158 high-tech firms in Taiwan. Second, a purposive sampling technique was also adopted to select 1:4 dyadic managers and employees relationships in the Research & Development (R&D) department of each selected sample firms. The valid of respondents is tested on 252 subordinates and 67 managers. Structural equation modeling (SEM) in AMOS 21 and hierarchical linear modeling (HLM 7) were used to test six research hypotheses.*
Findings: *At cross-level of analysis, the results of a hierarchical regression analysis indicated that person-organizational fit is positively related to emotional intelligence and innovation climate, respectively. The moderating role of leader openness is also confirmed in this study.At individual level of analysis, SEM showed that emotional intelligence is positively related to psychological safety, and psychological safety is positively related to innovation climate. Form mediation aspects by using a Sobel's test, the findings indicated that psychological safety is partially mediated the relationship between emotional intelligence and innovation climate. Therefore, these findings suggest that person-organizational fit and emotional intelligence can play very critical roles as predictors of innovation climate through a mediation of psychological safety.*
Research limitation/implications: *The main research limitations include the use of high-tech industries in Taiwan. This study also focused on subordinate-manager dyadic relationship in each of the R&D department, which seems to be a small portion of the total staffs of such organizations. Drawing upon person-organizational fit and the affective event theories, this study found that the emotional intelligence partially mediates the effect of person-organizational fit on psychological safety.These research findings may also provide significant contributions to both academics and professionals by which to understand matched pairs in employee-manager relationships in order to improve organizational innovation climate.*
Originality/value: *This study primary integrates the affective events and person-environment fit theories to test the comprehensive research framework of the influences of person-organizational*

fit on innovation climate through a mechanism of the cross-level mediationof emotional intelligence.

Keywords: person-organizational fit, leader openness, emotional intelligence, psychological safety, innovation climate
Paper type: Research paper

INTRODUCTION

Innovation is of great significance with regard to organizational effectiveness and competitive advantage(Hirst, Knippenberg, and Zhou, 2009; Saenz, Aramburu, and Rivera, 2009), and firm performance (Gong, Zhou, and Chang, 2013). Davila, Epstein, and Shelton (2006)indicated that superior innovation providescompanies with opportunities to grow faster, better, and smarter than theircompetitors.In the strategic management literature, innovation climateis recognized as a critical enabler for firms to create value and sustain competitive advantage in the increasingly complex and rapidly changing environment(Chen and Huang, 2009; Daft, 2007; Somech and Drach-Zahavy, 2013). Firms with greater innovativeness tend to be more successful in responding to changing environments and in developing new capabilities that allow them to achieve better performance(Montes, Moreno, and Fernandez, 2004), which result in increasing profits and market share (Baer and Frese, 2003). It is argued that process innovations are assumed to bring multiple benefits to an organization and help an organization achieve competitive advantage (Chen, Li, and Tang, 2009). In this paper we concentrate on key antecedents of innovation climate as a contingency and identify those determinant factors that positively affect innovation climate.

The antecedents of innovation climate have been proposed by several researchers (i.e., Baer and Frese, 2003; Elenkov and Manev, 2009; Gumusluoglu and Ilsev, 2009), however, no studies in organizational innovativeness have simultaneously examined the interrelationships among person-organization fit, leader openness, emotional intelligence, psychological safety, and innovation climate in either at organizational-level or individual-level of analysis. Therefore, this study draws upon multiple perspectives of person-environment fit theory (Kristof-Brown, Zimmerman, and Johnson, 2005), an extension of emotional intelligence research framework (Wong, Law, and Wong, 2004), and available literatures on leader openness (Detert and Burris, 2007), psychological safety (Detert and Burris, 2007; Troster and van Knippenberg, 2012) and innovation climate (Daft, 2007) to focus on three main research objectives. First, the cross-level mediation effect of emotional intelligence on the influence of person-organization fit and psychological safety, and second, the cross-level relationship of person-organization fit on emotional intelligence and psychological safety. Third, the individual-level relationships among emotional intelligence, psychological safety, and innovation climate are also examined by this study.

This study brings contributions to the literature in two important ways. First, by examining emotional intelligence as a cross-level mediation variable, this study extends previous research frameworks that have primarily examined the direct or main effect of person-organization fit on psychological climate and innovation climate (Lee and Wu, 2011). It is expected that the

mediators of this relationship may provide theoretical insight into the mechanism through which person-organization fit influences psychological safety and innovation climate. Second, this study operationalizes the stream of research on the impact of emotional intelligence on employee innovation climatethrough a mechanism of the mediating effect of psychological safety. Based on the above discussions, the following research framework is developed as shown in Figure 1.

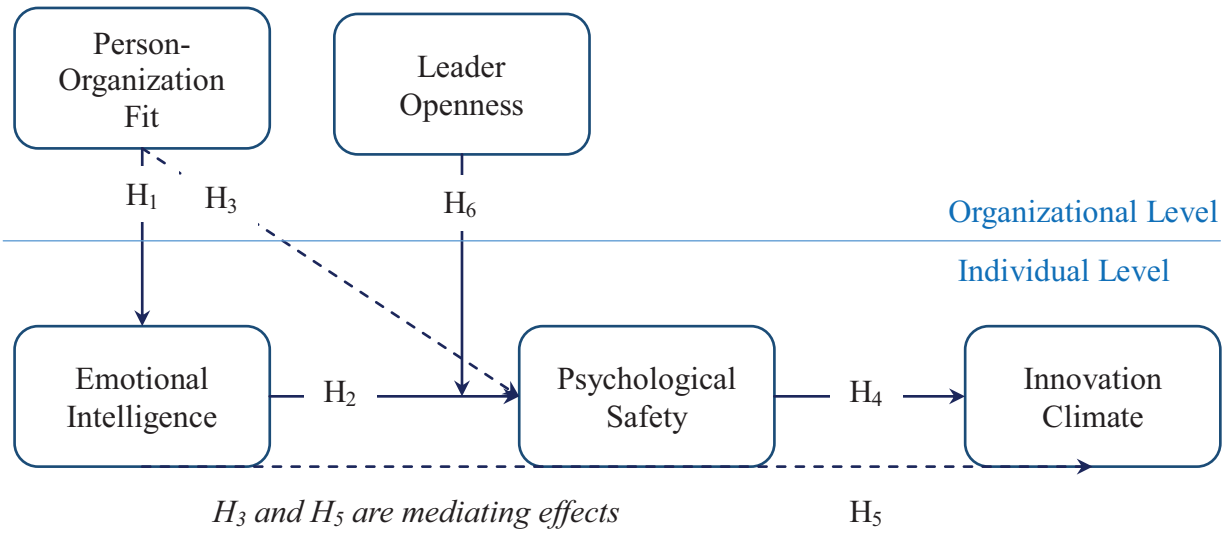


*Figure. 1*A cross-level mediation of emotional intelligence

THEORETICAL AND HYPOTHESES DEVELOPMENT

The effect of person-organization fit

Kristof-Brown et al.(2005) conducted a meta-analysis and empirically summarized the existing literature in four critical domains that included person-environment (PE) fit: person-job (PJ) fit (i.e., matching employees' skills, knowledge, and abilities to performing specific job-related tasks), person-organization (PO) fit (i.e., matching between the organization's values and individual values), person-group (PG) fit (i.e., matching employees' skills, knowledge, and abilities to both the complementary and supplementary requirements of the specific workgroup), and person-supervisor (PS) fit (i.e., the perceived fit between employee and supervisor characteristics (i.e., values, personality, and behavioral styles). Person-organization fit has been proposed and categorized as an organizational level (Werbel and DeMarie, 2005; Werbel and Johnson, 2001), thus person-organization fit is adopted for this study.

Person-organization fit has been suggested that organizational values may be an important factor influencing employee behaviors and attitudes (Tak, 2011; Van Vianen, Shen, and Chuang, 2011). Previous studies investigated the idea that employee attitudes should provide a more complete

picture of how perceived person-organization fit impacts their job satisfaction and performance (Glomb and Welsh, 2005; Kristof-Brown *et al.*, 2005). However, the antecedents of person-organization fit foremotional intelligence of employees have not been empirically tested.

This study argues that person-organization fit plays an important role in transforming organizational value and improving daily working environments (Kristof-Brown *et al.*, 2005; Van Vianen *et al.*, 2011). Employees with higher match with organizational values may experience an increase in their positive emotional intelligence (Kim, Cable, Kim, and Wang, 2009) based upon their individual responses to their work environment (Kristof-Brown *et al.*, 2005). When individuals have similar personal values to those of their organization, they are likely to experience higher levels of fit, which, in turn, enhance their emotional intelligence. Based on above the rationale, the following hypothesis is proposed:

Hypothesis 1: Person-organization fit positivelyaffects employee's emotional intelligence.

The effect of emotional intelligence

Mayer and Salovey(1997)describe emotional intelligence (EQ) as the ability to perceive emotions and to use them to improve performance on cognitive tasks, and to effectively regulate these emotions. According to Davies, Stankov, and Roberts (1998), EQ has been composed of four sub-dimensions (i.e., appraisal and expression of emotion in one's self, appraisal and recognition of emotion in others, regulation of emotion in one's self, and use of emotion to facilitate performance). These dimensions were validated by the recent studies on expatriate context (Wong *et al.*, 2004). EQ enables expatriates to grasp reason correctly with emotional concepts (Côté and Miners, 2006). Mol, Born, Willemsen, and Van Der Molen(2005), define EQ as an ability to perceive, adapt, and perform emotion effectively in new cultural settings. This study assumes that individuals with high EQ can understand their own deep emotions about psychological safety, and thus may be particularly able to maintain and regulate their emotions to complete innovation implementation effectively(Côté and Miners, 2006; Somech and Drach-Zahavy, 2013). Consequently, high EQ individuals are effective interpersonally and this may, in turn, enhance their psychological safety. Theory of person-environment fit suggests that emotionally intelligent individuals are likely to experience a higher level of psychological safety (Carmeli, Yitzhak-Halevy, and Weisberg, 2009; Mayer, Caruso, and Salovey, 1999). The above arguments suggest the following hypothesis.

Hypothesis 2: Emotional intelligencepositivelyaffects employee'spsychological safety.

The cross-level mediation effect of emotional intelligence

According to person-organization fit theory, person-organization fit may increase in employee's positive emotional intelligence (Ang and Van Dyne, 2008; Kristof-Brown *et al.*, 2005). Emotional intelligence has potential for improving safety-related efforts and other aspects of individuals' work (Wiegand, 2007). The key concept of emotional intelligence is associated with self-awareness, where individuals are able to identify their emotions and manage them in various social environments (Seligson and MacPhee, 2004). Emotional intelligence is positively

significant related to retention and workplace environment safety (Codier, Kooker, and Shoultz, 2008). At the work place emotional intelligence is to be developed and a favorable psychological work climate(Owolabi, 2012), which in turn is more likely to experience a higher level of psychological safety (Carmeli *et al.*, 2009). Thus, this study posits that person-organizationfit has influence on employee's emotional intelligence, which in turn to enhance employee's psychological climate. Based on above rationale, the following hypothesis is proposed:

Hypothesis 3: Emotional intelligencepositivelymediates the relationship between person-organization fit and psychological safety.

The mediation effect of psychological safety

As stated earlier, the key concept of emotional intelligence is to enhance employee's psychological safety (i.e., Codier *et al.*, 2008; Owolabi, 2012; Wiegand, 2007).Psychological safety refers to individuals shared belief about the consequences of interpersonal risk taking within the organization (Kessel, Kratzer, and Schultz, 2012). Psychological safety is associated with the work environment, such as the degree of supportive relationships and the degree to which innovation is promoted (Schneider, Smith, and Paul, 2001; Tordera, González-Roma, and Peiró, 2008). In turn, psychosocial safety determines work performance (Idris, Dollard, Coward, and Dormann, 2012), creative performance (Kessel *et al.*, 2012), leader-direct behavior (Troster and van Knippenberg, 2012), and team innovation (Peltokorpi and Hasu, 2013). It is argued that psychological safety can facilitate an organization's innovative climate (González-Roma, Peiró, and Tordera, 2002). Psychological safety is hypothesized to link innovation (Post, 2012). In line with previous study proposed that psychological safety partially mediated the relationship between the structural and cognitive capital and innovation (Gu, Wang, and Wang, 2013). Thus, this study posits that the influence of emotional intelligence on innovation climatewhile considering psychological climate as a mediating variable. Based on above research arguments, the following hypotheses are proposed:

Hypothesis 4: Psychological safety positively affects innovation climate.

Hypothesis 5: Psychological safety positively mediates the relationship between emotional intelligence and innovation climate.

The moderating **effect of leader openness**

Leader openness refers to the extent to which leaders engage with idea and suggestions from team or individual member in an open-minded fashion (Milliken, Morrison, and Hewlin, 2003). Leaders who are open to their subordinates' ideas and suggestions decrease the salient of power differential between leaders and subordinates and they may fear to speak up (Edmondson, 2003). Because leader openness signals subordinates that they may not be afraid of open criticism (Detert and Burris, 2007; Troster and van Knippenberg, 2012). This study hypothesized that when individual employees perceive higher levels of emotional intelligence, their psychological safety would be likely to increase. In addition, emotional intelligence would account for greater

variance in employee's psychological safety among individuals whose effort is determined by what managers perceived as being open to new ideas and suggestions. It is expected thatleader openness will moderate the relationship between emotional intelligence and psychological safety so that the relationship will be stronger for those individuals with highperceived leader openness. In turn, leader openness plays a very critical role in the extent to which employees will vary their psychological safety depending on the perceptions of emotional intelligence they receive from managers. Leader openness (Detert and Burris, 2007)may play an important role as a moderating variable in a cross-level effect that can improve the relationship between emotional intelligence and psychological safety. For example, leader openness may moderate the impact of emotional intelligence on employee's psychological safety in such a way that emotional intelligence relates more positively to employee's psychological safety when individual employee perceived leader openness is higher, rather than lower.Thus, the following hypothesis is proposed:

Hypothesis 7: Leader openness moderates the relationship between emotional intelligence and psychological safety such that employees with higher emotional intelligence will have higher levels of psychological safety.

METHOD

Samples and data collection

The sampling process of this study involved three phases. First, a random sampling technique was adopted to select 158 high-tech firms out of the 200 listed by the Common Wealth Magazine in Taiwan (2010). Second, a purposive sampling technique (i.e., quota sampling)(Cooper and Schindler, 2011) was also adopted to select 1:4 dyadic managers and employees relationships in each R&D department of the 158 firms. Finally, email based survey was used to send 5 questionnaires (one for manager and 4 for employees at the same department). In this stage, we requested via e-mail for the help of managers in each R&D department of each high-tech firm to identify employees as participants. A total of 78 high-tech firms were responded (i.e., cross-industrial zones in Taiwan), which included 78 managers and 234 employees from the R&D departments. Similarly, 11 high-tech firms (i.e., 11 managers and 33 employees) had to be excluded as outliers, and these were deleted using graphic methods, with a residual scatter plot in the range of ± 3 standard deviation. Finally, a total of 67 managers and 252 employees from 67 high-tech industries were determined to be usable. The effective responsive rate was 42.40 percent (67/158).As suggested by Saunders, Lewis, and Thornhill(2007), given that the likely response rate range between 30% and 50%, this response rate was viewed as adequate.

MEASUREMENT SCALES

Person-organization fit

Person-organization fit was assessed with three items which wereoperationalized from Kristof-Brown et al. (2005). The items were: "My values match or fit the values of this organization"; "I am able to maintain my values at this company"; and "My values support me to fit in at this

company because they are same withthe company's values." According toWerbel and DeMarie(2005), and Werbel and Johnson (2001), this study treats person-organization fit as an organizational-level of analysis and 3 to 4 employees of each sample firms were invited to rate these measurement items.

Leader openness

In line with Detert and Burris (2007), we used three items. The items were: "My supervisor is open to suggestions"; "Good ideas get serious consideration from my supervisor"; and "When good suggestions are made to my supervisor, they receive fair evaluation." According to Troster and van Knippenberg(2012), we treated leader openness as an organizational-level of analysis and3 to 4 employees were invited to rate these measurement items.

Emotional intelligence

Twelve items and 4 sub-dimensions of emotional intelligence were developed by Wong, Law and Wong(2004): 1) Self-emotional appraisal contains 3 items related to the statement: 'When I am upset, I will talk to someone who is close to me about my feelings'; 2) Other's emotional appraisal contains 3 items related to the statement: 'When a friend comes to me because he/she is not happy, I will share his/her feeling'; 3) Regulation of emotion contains 3 items related to the statement: 'When you have to do something you don't like, you will try to gain something interesting from it'; and 4) Use of emotion contains 3 items related to the statement: 'When you face problems regarding your work, you will handle the problem yourself because everyone should deal with his/her own life'. We treated emotional intelligence as an individual-level of analysis and self-rating scales were rated by 3 to 4 individual subordinates.

Psychological safety

Psychological safety was assessed with three items which were adopted from Troster and van Knippenberg(2012). The items were: "It is safe for me to speak up around here"; "In this organization, I feel safe to discuss problems and difficult issues"; and "I this organization, I feel safe to say my opinion and make suggestions for improvement even when other disagree." We treated psychological safety as an individual-level of analysis and self-rating scales were rated by 3 to 4 individual subordinates.

Innovation climate

Six items of innovative climatewere operationalized from Daft (2007). The items were: "My firm provides the climate for me to search out new technologies,processes, techniques, and/or product ideas"; " Firm provides the climate for individuals to generate creative ideas"; "Firm provides the climate for individuals to promote and champion ideasto others"; "Firm provides the climate for individuals to investigate and secure funds toimplement new ideas"; "Firm provides the climate for individuals to develop adequate plans andschedules for the implementation of new ideas"; and "Firm provides the climate for individuals to be innovative". We treated innovation

climate as an individual-level of analysis and 1 manager was invited to rate 3 to 4 individual subordinates.

All measurement item scales were measured in a-point 7Likert scale (i.e. from 1 = 'strongly disagree' to 7 = 'strongly agree'). The questionnaire items weretranslated from English to Chinese. A standardtranslation and back-translation procedurewas adopted to ensure the accuracy of the meaning of measurement items.

Analytic procedure

Person-organization fit ratings by the subordinateswere aggregated to the organizational level by averagingtheir values for each organization.The Intraclass Correlation Coefficients (ICCs—ICC1 and ICC2) technique was adopted to assess the interrater reliability of judgments as provided by each department and organization. The term *interrater reliability* is used here to refer to the degree to which judges are "inter-changeable", which is to say the extent to which judges "agree" on a set of "judgments" (James, Demaree, and Wolf, 1984, p. 86).The ICC1 coefficient represents the proportion of variance in ratings at an individual level that is attributed to group membership; whereas the ICC2 coefficient represents the reliability of the group level means (Bliese, 2000). According to James et al. (1984) and Mathieu, Gilson, and Ruddy (2006), the minimum cut-off value for ICC1 is .12, and for ICC2, it is .60. One-way ANOVA was implemented to provide empirical justification foraggregating subordinate ratings of person-organization fit.The results showed that between-group differences weresignificantly higher than within-group differences (person-organization fit: $F=3.26,\ p<.001$). The ICC1of person-organization fit was .325;the ICC2 of person-organization fit was .72.The within-group agreement ($r_{wg(j)}$) was also calculated at an organizational level of analysis. In the case of the 67high-tech firms, the mean of their $r_{wg(j)}$ was .85 for person-organization fit. All of the means$r_{wg(j)}$ were greater than the conventionally accepted value of .70 (James, Demaree, and Wolf, 1993). Taken together, these results showed thataggregation was appropriate and acceptable for theseresearch constructs.

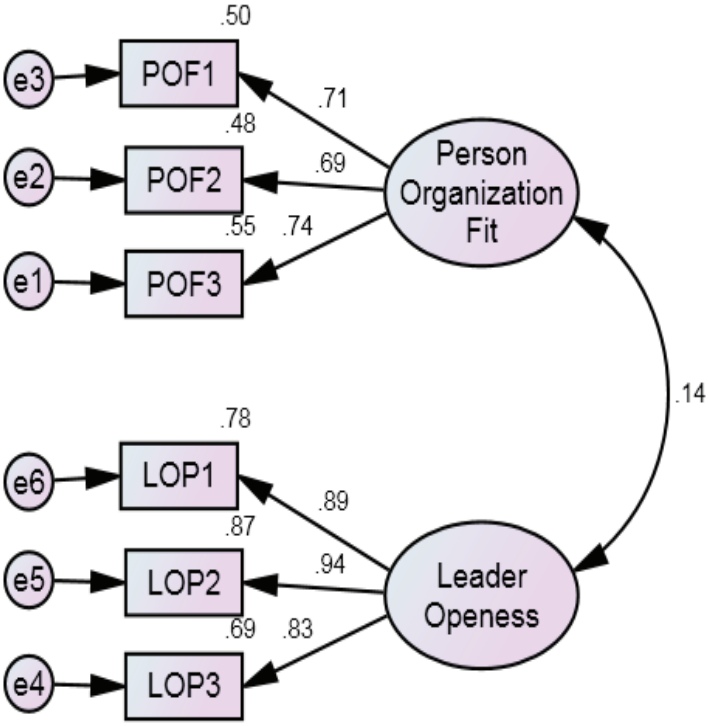
This study employed a cross-level meditational and moderational framework between an organizational level and an individual level of analysis. To test the cross-level mediation and moderation effects of Hypotheses 1, 3, and 6, we adopted thestatistical procedures as proposed by Mathieu, Maynard, Taylor, Gilson, and Ruddy, (2007), and Mathieu and Taylor (2007). Hierarchical linear modeling (HLM 7) was used to test the cross mediation and moderation relationships (Hofmann, Giffin, and Gavin, 2000; Raudenbush and Bryk, 2002). At the individual-level of analysis, structural equation modeling (SEM) (i.e., software package AMOS 21 and SPSS 19) was adopted to test hypotheses H2, H4, and H5, respectively.

Confirmatory factor analysis (CFA)

Confirmatory factor analysis (CFA) was performed using AMOS 21 to evaluate the distinctiveness of the measures used in the present study. Anderson and Gerbing's(1988) procedure was adopted to assess the convergent and construct validity of measurement model. According to Koufteros, Babbar, and Kaighobadi(2009), the CFA procedure consists of two

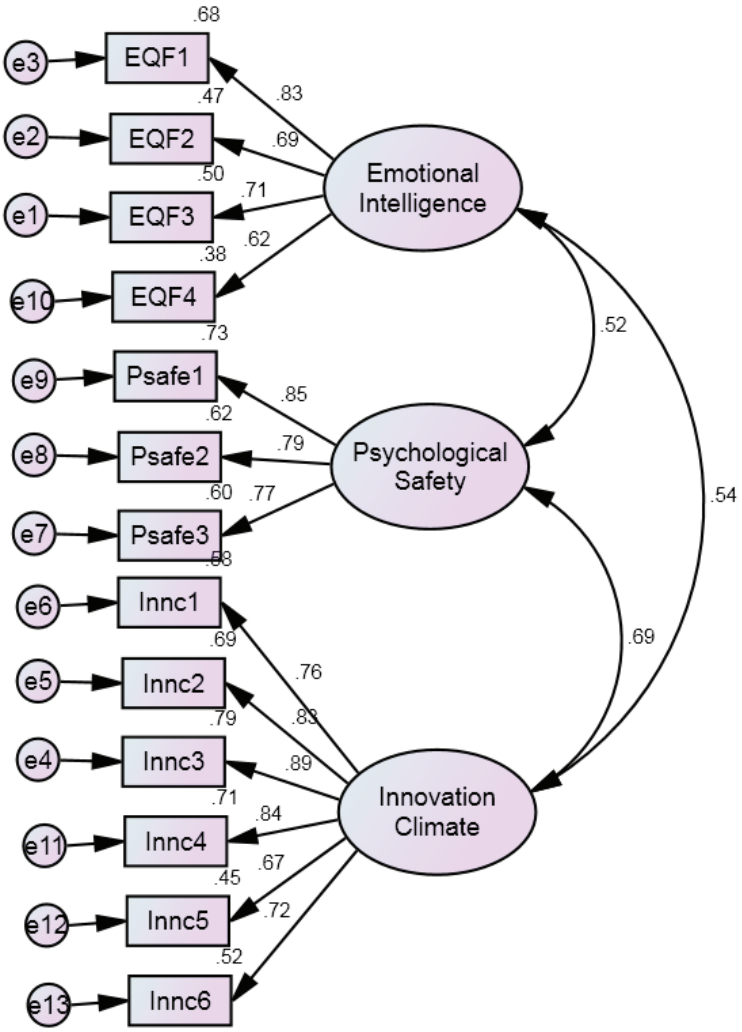
factor models, such as a first order-factor model and a second order-factor model. A first order-factor model was adopted to examine the individual research constructs of both levels of analyses (i.e., organizational and individual levels), and the results of this procedure indicated that the standardized loading for all items exceeded .70 and that the t-values higher than 1.96 ($p < .05$), thus satisfying the threshold recommended by Hair, Black, Babin, and Anderson, (2010) and Kline (2011). Then, a second-order factor model was conducted to examine the overall model fit of each research construct at both levels of analyses. The following goodness of fit indices were chosen for this analysis, based on suggestions that can be found in previous studies (Bagozzi and Yi, 1988; Baumgartner and Homburg, 1996; Hair et al., 2010; Koufteros et al., 2009; Shumacker and Lomax, 2004).

The results of overall CFA of organizational-level analysis (Fig.2) showed that absolute fit indices (i.e., χ^2=10.49; df=7; χ^2/df= 1.499; GFI=.953; AGFI=.858; RMR=.065) and incremental fit indices (NNFI= .951; CFI=.982) were appropriate. At the individual-level of analysis (Fig.3), the results showed that the overall goodness-of-fit assessment satisfied the threshold of (i.e., χ^2=69.255; df=55; χ^2/df= 1.259; GFI=.962; AGFI=.937; RMSEA=.017) and incremental fit indices (NNFI= .964; CFI=.992) all achieved the minimums threshold. Thus, the model fit assessment of both levels (i.e., organizational level and individual level) can be presented as a good model fit with adequate convergent validity and construct reliability (Gerbing and Anderson, 1992; Hair *et al.*, 2010). Therefore, descriptive statistics, including means, standard deviations, coefficient alpha, and correlations among the research variables are reported in Tables 1 and 2, respectively.



Model=Standardized estimates
Group=Group number 1
Ch-square=10.490,
df=7, Chi-square/df=1.499,
GFI=.953 , AGFI=.858,
NFI=.951, CFI=.982,
RMR=.065, RMSEA=.087, P=.162

Figure-2 The results of overall CFA—Organizational-level of analysis



Model=Standardized estimates
Group=Group number 1
Ch-square=69.255,
df=55, Chi-square/df=1.259,
GFI=.962 , AGFI=.937,
NFI=.964, CFI=.992,
RMR=.017, RMSEA=.032, P=.094

*Figure-3*The results of overall CFA—Individual-level of analysis

Table 1 Descriptive statistic and correlations (Organizational-Level, N=67)

Variables	Mean	Std. Deviation	1	2	3	4
1. Person-organization fit	5.470	.701	**.777**			
2. Leader openness	4.872	1.020	.053*	**.913**		
3. Education	1.343	.617	-.098	-.047	n/a	
4. Job Tenure	1.567	.802	-.008	-.042	.734**	n/a

Note:
**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
Cronbach's alpha (α) is shown on the diagonal. n/a= not available.

Table 2 Descriptive statistic and correlations (Individual-Level, N=252)

Variables	Mean	Std. D	1	2	3	4	5	6	7	8
5. EQF1	3.609	.723	**.750**							
6. EQF2	3.729	.747	.578**	**.798**						
7. EQF3	3.911	.713	.552**	.523**	**.776**					
8. EQF4	3.427	.797	.557**	.384**	.453**	**.856**				
9. PSFT	3.873	.649	.434**	.268**	.334**	.365**	**.843**			
10. INNC	3.800	.636	.416**	.358**	.379**	.285**	.595**	**.915**		
11. Education	1.611	.813	.127*	.016	-.036	-.034	.055	.024	n/a	
12. Job Tenure	1.552	.753	.087	-.04	-.030	.039	.065	-.052	.410**	n/a

Note:
**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
Cronbach's alpha (α) is shown on the diagonal. n/a= not available.

Emotional intelligence (i.e., EQF1= Self-emotional appraisal; EQF2= Other's emotional appraisal; EQF3= Regulation of emotion; EQF4= Use of emotion); PSFT = Psychological safety; INNC=Innovation climate.

RESEARCH FINDING

Cross-level mediation and moderation effects (HLM)

As shown in Table 3, theperson-organization fit has positive and significant effect on emotional intelligence (γ_{02}=.314, p<.001, R^2=.237), which provided support for Hypothesis 1.By testing the cross-level mediation effect of Hypothesis 3, four conditions of mediation procedures were adopted from Mathieu et al.(2007), and Mathieu and Taylor (2007). Furthermore, theresults also showed that emotional intelligence is partially mediated the relationship between person-organization fit and psychological safety also has a positive and significant influence on employee engagement (γ_{03}=.266, p<.05, R^2=.198) which confirmed Hypothesis 3. The results in Table 4also indicated that leader openness positively moderates the relationship between

emotional intelligence and psychological safety (γ_{02}=.186, p<.05, R^2=.158), which confirmed Hypothesis 6.

Table 3 The results of HLM (cross-level and cross-level interaction)

Independent variables	Dependent variables	
Individual-level (N=252)	Emotional intelligence	Psychological safety
	Hypothesis 1	Hypothesis 3
Education (γ_{05})	.019	.055
Job Tenure (γ_{04})	.033	.045
Organizational-level (N=67)		
Person-organization fit (γ_{02})	.314***	-
Cross-level interaction		
Leader openness x emotional intelligence (γ_{03})	-	.226**
R^2	.237	.198

Note: *** p< .001, ** p< .05. They are significant at a *t-value*> |1.96|. γ =Intercept (standardized coefficient). R^2 calculations were computed following Hofmann et al. (2000) and HofmannMorgeson, andGerras(2003).

Table 4 The results of HLM (cross-level mediation)

Independent variables	Dependent variable			
	Psychological safety			
	Step 1	Step 2	Step 3	Step 4
Individual-level (N=252)				
Education (γ_{04})	.116**	.061	.117*	.191**
Job Tenure (γ_{03})	.086	.021	.065	.092
Emotional intelligence (γ_{01})	-	-	.218**	.291***
Organizational-level (N=67)				
Transformational leadership (γ_{02})	.315**	.314**	-	.186**
R^2				. 158

Note: *** p< .001, ** p< .05, * p< .01. They are significant at a *t-value*> |1.96|. γ =Intercept (standardized coefficient). R^2 calculations were computed following Hofmann et al. (2000) and Hofmann et al.(2003).

Structural equation modeling (SEM)

Structural equation modeling (SEM) was adopted to test the maximum likelihood estimate method, and Hypotheses 2, 4, and 6. The results showed (see Figure 4) that χ^2 = 74.932; df = 57; GFI = .958; AGFI = .933; RMR =.016, and p=.056, all of which satisfied the threshold as suggested by Hair et al. (2010). Hypothesis 2 predicted emotional intelligence to have a positive

effect on psychological safety. The findings provided support for Hypothesis 2 (β=.552; p <.001; t= 6.446). Hypothesis 4 predicted psychological safety to have a positive effect on innovation climate. The results provided support Hypothesis 4 (β=.563; p <.001; t= 7.268). As suggested by Baron and Kenny's test (1986)and (i.e., structural models of First: independent variable must be shown to be significant related to the mediator; Second: independent variable must be shown to be significant related to the dependent variable, and Third: mediator must affect the dependent variable) which indicated that psychological safety has partially mediated the relationship between emotional intelligence and innovation climate. This notion is in line with Sobel's test (1982) which illustrated that z-test statistic must be exceeded a value of t-test=|1.96|. In this study z-test was 4.541>|1.96| and significant at p<.001 (more details of z-test can be seen (more details of z-test can be seen in Iacobucci, 2012; MacKinnon and Cox, 2012). Therefore, we assume that psychological safety plays an important role as mediating effect, as proposed in Hypothesis 5.

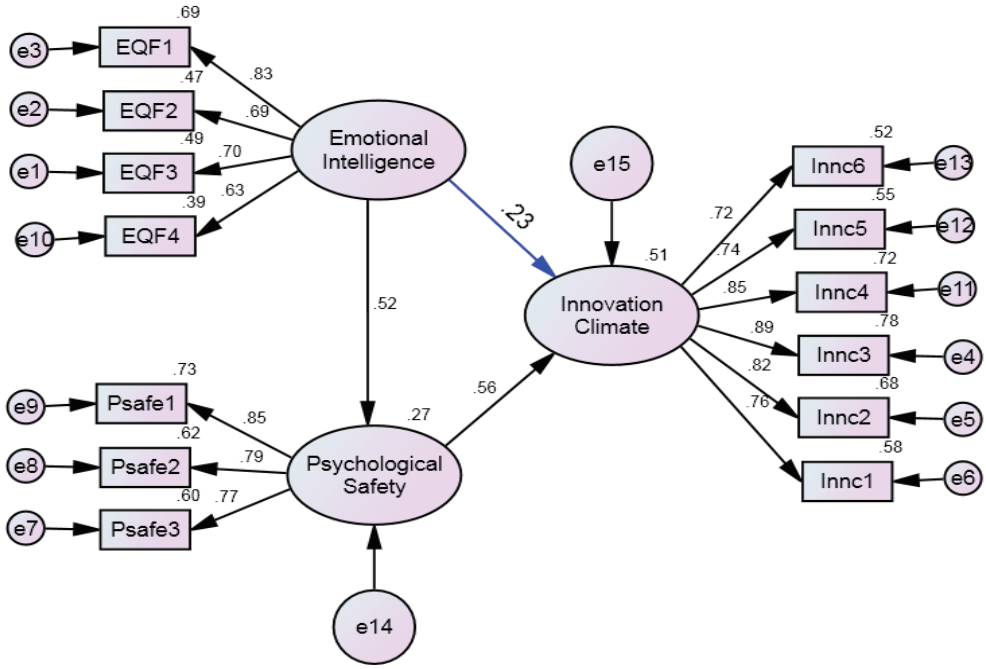


Figure-4 The results of SEM—Individual-level of analysis (N=252)

RESEARCH DISCUSSIONS

This study drew from multiple perspective theory of person-environment fit, and an extension of extension of emotional intelligence research framework, available literatures on leader openness, psychological safety, and innovation climate to explain the proposed hypotheses. Empirical data collected from two different sources, including managers (organizational-level) and subordinates (individual-level), were analyzed. At the cross-level of analysis, the research findings indicated the effect of person-organization fit on emotional intelligence (H1) is significant. This is confirmed that employees with higher match with organizational values may experience an increase in their positive emotional intelligence (Kim *et al.*, 2009).

At the cross-level mediation and moderation of analysis, the findings of this study showed that emotional intelligence partially mediated the relationship between person-organization fit and psychological safety (H3).This is confirmed that person-organization fit may increase in employee's positive emotional intelligence (Kristof-Brown *et al.*, 2005; Owolabi, 2012), which in turn to likely to experience a higher level of psychological safety (Carmeli *et al.*, 2009). The research findings also found that leader opennesshas a positive moderating effect the relationship between emotional intelligence and psychological safety (H5). This is confirmed by this study and expected that leader openness may play an important role as a moderating variable in a cross-level effect that can improve the relationship between emotional intelligence and psychological safety(Detert and Burris, 2007; Troster and van Knippenberg, 2012).

At the individual-level of analysis, the results of SEM showed that emotional intelligence has significant effect on psychological safety (H2). This is consistent with research arguments as proposed by previous studies (i.e., Carmeli *et al.*, 2009; Côté and Miners, 2006; Somech and Drach-Zahavy, 2013), which argued that individuals with higher emotionally intelligence are likely to experience a higher level of psychological safety. Indeed, psychological safety has found to be significant positively related to innovation climate (H4). This is in line with previous research arguments as proposed by recent studies (i.e., Gu *et al.*, 2013; Peltokorpi and Hasu, 2013; Post, 2012), which argued that psychological safety is hypothesized to enhance organizational innovation and innovation climate. The results also indicated that psychological safety partially mediated the relationship between emotional intelligence and innovation climate (H5). This is confirmed by this study.

Implications and Future Research

Although the present study provides valuable insights into an understanding of the extension literature of person-environment fit, emotional intelligence, psychological safety, and personality traits (i.e., leader openness)to explore innovation climate through a mechanism of cross-level mediation effects of emotional intelligence, there are a few limitations that should be recognized and these may provide a departure for future research. First, although there is theoretical and empirical support both the mediation and the moderationof our research model, using the 67 high-tech firms in Taiwan as the sample, the sample size may need to be increased. Second, this studystudy focused on subordinate-manager pairs in each of the R&D department, which seems to be a small portion of the total staffs of such organizations. Therefore, future research should

take a closer look at cross-functional units or teams rather than single units alone. This study proposes that cross-functional units (i.e., R&D, marketing, and HRM departments) will also be important for the developing and creating innovation climate. Thus, individuals from cross-functional units need to bring together to perform unique tasks to create innovative services designed to achieve high levels of organizational performance and customer service (Lussier&Achua, 2007). Third, this study failed to prove that two control variables (i.e., educational and job tenure) are significantly related to their innovation climate. This study suspected that cultural effects including power distance and collectivism(Farh, Hackett, and Liang, 2007; Kirkman, Chen, Farh, and Lowe, 2009) may impact the results of this study. Future research should replicate the findings in this study byusing samples from different cultural contexts.

Fourth, this study argues that hiring employees who belong to Gen Y are key human assets and capitals in terms of effectively adopting new learning processes and creating new ideas to innovate services or products in order to meet customer expectations, as well as increase the market share. Similarly, Gen Yers are even more comfortable with technology and are able to make use of collaborative tools such as cell phones, and social networking platforms to communicate with others and facilitate a collective process of creative problem solving (Mhatre and Conger, 2011). Indeed, Gen Y individuals exhibit a greater preference for seeking guidance, and supervision from their superiors. They tend to follow directions well, value collaboration and teamwork (Dolezalek, 2007; Hastings, 2008). However, Gen Yers seem to be in lack of cooperation and communication with leaders (i.e., Erickson, Alsop, Nicholson, and Miller, 2009). Gen Yers are less loyal to their employers than previous generations (i.e., Durkin, 2008; Hira, 2007). Along with these debates should be further addressed by future study.

In summary, the results presented here contribute to our understanding of how the mechanisms of the effect of emotional intelligence and psychological safety can manipulate innovation climate and offer insights on how to enhance organizational innovation from various person-organizational fit perspectives. These research findings may also provide significant in this study have contributed to both academics and professionals to understand how matched pairs in employee-supervisor relationships can improve emotional intelligence and psychological safety and meet the demands of organizational innovation, as well as organizational expectations.

REFERENCES

1. Anderson, J. C., and Gerbing, D. W. (1988), "Structural equation modeling in practice: A review and recommended two-step approach", Psychological Bulletin, Vol.103 No.3, pp. 411-423.
2. Ang, S., and Van Dyne, L. (2008), "Conceptualization of cultural intelligence: Definition, distinctiveness, and nomological network", In S. Ang and L. Van Dyne (Eds.), Handbook of cultural intelligence: Theory, measurement, and applications, Armonk, New York: M.E Sharpe, pp. 3-15.

3. Baer, M., and Frese, M. (2003), "Innovation is not enough: Climates for initiative and psychological safety, process innovations, and firm performance", Journal of Organizational Behavior, Vol.24 No.1, pp. 45-68.
4. Bagozzi, R. P., and Yi, Y. (1988), "On the evaluation of structural equation models", Journal of the Academy of Marketing Science, Vol.16 No.1, pp. 74-94.
5. Baron, R. M., and Kenny, D. A. (1986), "The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations", Journal of Personality and Social Psychology, Vol.55 No.6, pp. 1173-1182.
6. Baumgartner, H., and Homburg, C. (1996), "Applications of structural equation modeling in marketing and consumer research: A review", International Journal of Research in Marketing, Vol.13 No.2, pp. 139-161.
7. Bliese, P. D. (2000), "Within-group agreement, non-independence, and reliability: Implications for data aggregation and analyses", In K. J. Klein and S. W. J. Kozlowski (Eds.), Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions, San Francisco: Jossey-Bass,
8. Carmeli, A., Yitzhak-Halevy, M., and Weisberg, J. (2009), "The relationship between emotional intelligence and psychological wellbeing", Journal of Managerial Psychology, Vol.24 No.1, pp. 66-78.
9. Chen, and Huang, J. W. (2009), "Strategic human resource practices and innovation performance: The mediating role of knowledge management capacity", Journal of Business Research, Vol.62, pp. 104-114.
10. Chen, C.-H., Li, H.-H., and Tang, Y.-Y. (2009), "Transformational leadership and creativity: exploring the mediating effects of creative thinking and intrinsic motivation", International Journal of Management and Enterprise Development, Vol.6 No.2, pp. 198-211.
11. Codier, E., Kooker, B. M., and Shoultz, J. (2008), "Measuring the emotional intelligence of clinical staff nurses: An ppproach for improving the clinical care environment", Nursing Administration Quarterly, Vol.32 No.1, pp. 8-14
12. Cooper, D. R., and Schindler, P. S. (2011), Business research methods, New York: McGraw Hill.
13. Côté, S., and Miners, C. T. H. (2006), "Emotional intelligence, cognitive intelligence, and job performance", Administrative Science Quarterly Vol.51 No.1, pp. 1-28.
14. Daft, R. L. (2007), Understanding the theory and design of organization, China: Thomson-South Western.
15. Davies, M., Stankov, L., and Roberts, R. D. (1998), "Emotional intelligence: In search of an elusive construct", Journal of personality and social psychology, Vol.75 No.4, pp. 989-1015.
16. Davila, T., Epstein, M. J., and Shelton, R. E. (2006), Making innovation work: How to manage it, measure it, and profit from it, Upper Saddle River, NJ: Pearson Education.

17. Detert, J. R., and Burris, E. R. (2007), "Leadership behavior and employee voice: Is the door really open?", Academy of Management Journal, Vol.50 No.4, pp. 869-884.
18. Dolezalek, H. (2007), "X-Y Vision", Training, Vol.44 No.6, pp. 22-27.
19. Durkin, D. (2008), "Youth movement", Communication World, Vol.25, pp. 23-26.
20. Edmondson, A. C. (2003), "Speaking up in the operating room: How team leaders promote learning in interdisciplinary action teams", Journal of Management Studies, Vol.40 No.6, pp. 1419-1452.
21. Elenkov, D. S., and Manev, I. M. (2009), "Senior expatriate leadership's effects on innovation and the role of cultural intelligence", Journal of World Business, Vol.44 No.4, pp. 357-369.
22. Erickson, T., Alsop, R., Nicholson, P., and Miller, J. (2009), "Gen Y in the workforce", Harvard Business Review, Vol.87 No.6, pp. 43-49.
23. Farh, J.-L., Hackett, R. D., and Liang, J. (2007), "Individual-level cultural values as moderators of perceived organizational support—employee outcome relationships in china: comparing the effects of power distance and traditionality", Academy of Management Journal, Vol.50 No.3, pp. 715-729.
24. Gerbing, D. W., and Anderson, J. C. (1992), "Monte Carlo evaluations of goodness of fit indices for structural equation models", Social Methods & Research Vol.21, pp. 132-160.
25. Glomb, T. M., and Welsh, E. T. (2005), "Can opposites attract? Personality heterogeneity in supervisor-subordinate dyads as a predictor of subordinate outcomes", Journal of Applied Psychology, Vol.90 No.4, pp. 749-757.
26. Gong, Y., Zhou, J., and Chang, S. (2013), "Core knowledge employee creativity and firm Performance: The moderating role of riskiness orientation, firm size, and realized absorptive capacity", Personnel Psychology, Vol.In Press, pp.
27. González-Roma, V., Peiró, J. M. a., and Tordera, N. (2002), "An examination of the antecedents and moderator influences of climate strength", Journal of Applied Psychology, Vol.87, pp. 465-473.
28. Gu, Q., Wang, G. G., and Wang, L. (2013), "Social capital and innovation in R&D teams: The mediating roles of psychological safety and learning from mistakes", R&D Management, Vol.43 No.2, pp. 89-102.
29. Gumusluoglu, L., and Ilsev, A. (2009), "Transformational leadership, creativity, and organizational innovation", Journal of Business Research, Vol.62 No.4, pp. 461-473.
30. Hair, J., Black, W., Babin, B. J., and Anderson, R. E. (2010), Multivariate data analysis, New Jersey: Prentice Hall.
31. Hastings, R. R. (2008), "Millennials expect a lot from leaders", HR Magazine, Vol.53 No.1, pp. 30-30.
32. Hira, N. A. (2007), "You raised them, now manage them", Fortune, Vol.155 No.10, pp. 38-46.

33. Hirst, G., Knippenberg, D. V., and Zhou, J. (2009), "A cross-level perspective on employee creativity: Goal orientation, team learning behavior, and individual creativity", Academy of Management Journal, Vol.52 No.2, pp. 280-293.

34. Hofmann, D. A., Giffin, M. A., and Gavin, M. B. (2000), "The application of hierachical linear modeling to organizational research", In K. J. Klein and S. W. J. Kozlowski (Eds.), Multilevel theory, research, and methods in organization: Foundation, extensions, and directions, San Francisco: Jossey-Bass, pp. 467-511.

35. Hofmann, D. A., Morgeson, F. P., and Gerras, S. J. (2003), "Climate as a moderator of the relationship between leader-member exchange and content specific citizenship: Safety climate as an exemplar", Journal of Applied Psychology, Vol.88 No.1, pp. 170-178.

36. Iacobucci, D. (2012), "Mediation analysis and categorical variables: The final frontier", Journal of Consumer Psychology, Vol.22 No.4, pp. 582-594.

37. Idris, M. A., Dollard, M. F., Coward, J., and Dormann, C. (2012), "Psychosocial safety climate: Conceptual distinctiveness and effect on job demands and worker psychological health", Safety Science, Vol.50 No.1, pp. 19-28.

38. James, L. R., Demaree, R. G., and Wolf, G. (1984), "Estimating within-group interater reliability with and without response bias", Journal of Applied Psychology, Vol.69 No.1, pp. 85-98.

39. James, L. R., Demaree, R. G., and Wolf, G. (1993), "rwg: An assessment of within-group interrater agreement", Journal of Applied Psychology, Vol.78 No.5, pp. 306-309.

40. Kessel, M., Kratzer, J., and Schultz, C. (2012), "Psychological safety, knowledge sharing, and creative performance in healthcare teams", Creativity and Innovation Management, Vol.21 No.2, pp. 147-157.

41. Kim, T.-Y., Cable, D. M., Kim, S.-P., and Wang, J. (2009), "Emotional competence and work performance: The mediating effect of proactivity and the moderating effect of job autonomy", Journal of Organizational Behavior, Vol.30 No.7, pp. 983-1000.

42. Kirkman, B. L., Chen, G., Farh, J.-L., and Lowe, K. B. (2009), "Individual power distance orientation and follower reactions to transformational leaders: A cross-level, cross-cultural examination", Academy of Management Journal, Vol.52 No.4, pp. 744-764.

43. Kline, R. B. (2011), Principles and practice of structural equation modeling, New York: Guilford Press.

44. Koufteros, X., Babbar, S., and Kaighobadi, M. (2009), "A paradigm for examining second-order factor models employing structural equation modeling", International Journal of Production Economics, Vol.120 No.2, pp. 633-652.

45. Kristof-Brown, A. L., Zimmerman, R., and Johnson, E. C. (2005), "Consequences of individuals' fit at work: A meta-analysis of person-job, person-organization, person-group, and person-supervisor fit", Personnel Psychology, Vol.58 No.2, pp. 281-342.

46. Lee, F. H., and Wu, W. Y. (2011), "The relationships between person-organization fit, psychological climate adjustment, personality traits, and innovative climate: Evidence from Taiwanese hightech expatriate managers in Asian countries", African Journal of Business Management, Vol.5 No.15, pp. 6415-6428.
47. MacKinnon, D. P., and Cox, M. C. (2012), "Commentary on “mediation analysis and categorical variables: The final frontier” by Dawn Iacobucci", Journal of Consumer Psychology, Vol.22 No.4, pp. 600–602.
48. Mathieu, J. E., Gilson, L. L., and Ruddy, T. M. (2006), "Empowerment and team effectiveness: An emperical test of an intergrated model", Journal of Applied Psychology, Vol.91 No.1, pp. 97-108.
49. Mathieu, J. E., Maynard, M. T., Taylor, S. R., Gilson, L. L., and Ruddy, T. M. (2007), "An examination of the effects of organizational district and team contexts on team processes and performance: A meso-mediational model", Journal of Organizational Behavior, Vol.28 No.7, pp. 891-910.
50. Mathieu, J. E., and Taylor, S. R. (2007), "A framework for testing meso-mediational relationships in organizational behavior", Journal of Organizational Behavior, Vol.28 No.2, pp. 141-172.
51. Mayer, J. D., Caruso, D., and Salovey, P. (1999), "Emotional intelligence meets traditional standards for an intelligence", Emotional Intelligence: Key readings on the Mayer and Salovey model, Vol.27, pp. 267-298.
52. Mayer, J. D., and Salovey, P. (1997), "What is emotional intelligence?", In P. Salovey and D. J. Sluyter (Eds.), Emotional Development and Emotional Intelligence, New York: Basic Books, pp. 3-31.
53. Mhatre, K. H., and Conger, J. A. (2011), "Bridging the gap between Gen X and Gen Y", Journal of Leadership Studies, Vol.5 No.3, pp. 72-76.
54. Milliken, F. J., Morrison, E. W., and Hewlin, P. F. (2003), "An exploratory study of employee silence: Issues that employees don’t communicate upward and why", Journal of Management Studies, Vol.40 No.6, pp. 1453-1476.
55. Mol, S. T., Born, M. P., Willemsen, M. E., and Van Der Molen, H. T. (2005), "Predicting expatriate job performance for selection purposes", Journal of Cross-Cultural Psychology, Vol.36 No.5, pp. 590-620.
56. Montes, F. J. L., Moreno, A. R., and Fernandez, L. M. M. (2004), "Assessing the organizational climate and contractual relationship for perceptions of support for innovation", International Journal of Manpower, Vol.25 No.2, pp. 167–180.
57. Owolabi, A. B. (2012), "Effect of psychological work climate and emotion intelligence on teamwork", Journal of Asian Scientific Research, Vol.2 No.3, pp. 150-158.
58. Peltokorpi, V., and Hasu, M. (2013), "How participative safety matters more in team innovation as team size increases", Journal of Business and Psychology, Vol.In Press, pp.

59. Post, C. (2012), "Deep-level team composition and innovation: The mediating roles of psychological safety and cooperative learning", Group & Organization Management, Vol.37 No.5, pp. 555-588.

60. Raudenbush, S. W., and Bryk, A. S. (2002), Hierarchical linear models: Applications and data analysis methods, Newbury Park, CA: Sage.

61. Saenz, J., Aramburu, N., and Rivera, O. (2009), "Knowledge sharing and innovation performance: A comparison between high-tech and low-tech companies", Journal of Intellectual Capital, Vol.10 No.1, pp. 22-36.

62. Saunders, M., Lewis, P., and Thornhill, A. (2007), Research methods for business students, London: Prentice Hall.

63. Schneider, B., Smith, D. B., and Paul, M. C. (2001), "P-E fit and the attraction-selection-attrition model of organizational functioning: Introduction and overview", In M. Erez, U. Kleinbeck and H. Thierry (Eds.), Work motivation in the context of a globalizing economy, Mahwah: Erlbaum, pp. 231-246.

64. Seligson, M., and MacPhee, M. (2004), "Emotional intelligence and staff training in after-school environments", New Directions for Youth Development, Vol.2004 No.103, pp. 71-83.

65. Shumacker, R., and Lomax, R. G. (2004), A beginner's guide to structural equation modeling, Mahwah, New Jersey: Lawrence Erlbaum.

66. Sobel, M. E. (1982), "Asymptotic confidence intervals for indirect effects in structural equation models", Sociological Methodology, Vol.13 No.1982, pp. 290-312.

67. Somech, A., and Drach-Zahavy, A. (2013), "Translating team creativity to innovation implementation: The role of team composition and climate for innovation", Journal of Management, Vol.39 No.3, pp. 684-708.

68. Tak, J. (2011), "Relationships between various person-environment fit types and employee withdrawal behavior: A longitudinal study", Journal of Vocational Behavior, Vol.78 No.2, pp. 315-320.

69. Tordera, N., González-Roma, V., and Peiró, J. M. a. (2008), "The moderator effect of psychological climate on the relationship between leader –member exchange (LMX) quality and role overload", European Journal of Work and Organizational Psychology, Vol.17 No.1, pp. 55-72.

70. Troster, C., and van Knippenberg, D. (2012), "Leader openess, nationality dissimilarity, and voice in multinational management teams.", Journal of International Business Studies, Vol.43 No.6, pp. 591-613.

71. Van Vianen, A. E. M., Shen, C. T., and Chuang, A. (2011), "Person–organization and person–supervisor fits: Employee commitments in a Chinese context", Journal of Organizational Behavior, Vol.32 No.6, pp. 906-926.

72. Werbel, J. D., and DeMarie, S. M. (2005), "Aligning strategic human resource management and person–environment fit", Human Resource Management Review, Vol.15 No.4, pp. 247-262.

73. Werbel, J. D., and Johnson, D. J. (2001), "The use of person–group fit for employment selection: A missing link in person–environment fit", Human Resource Management, Vol.40 No.3, pp. 227-240.

74. Wiegand, D. M. (2007), "Exploring the role of emotional intelligence in behavior-based safety coaching", Journal of Safety Research, Vol.38 No.4, pp. 391-398.

75. Wong, C.-S., Law, K. S., and Wong, P.-M. (2004), "Development and validation of a forced choice emotional intelligence measure for Chinese respondents in Hong Kong", Asia Pacific Journal of Management, Vol.21 No.4, pp. 535-559.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE ANTECEDENTS AND MEDIATORS OF NEW PRODUCT DEVELOPMENT SUCCESS

Les Tien-Shang Lee, Department of International Trade, Graduate College of Management School of Business, Kun Shan University, Taiwan
Email: llee321@mail.ksu.edu.tw

ABSTRACT

Purpose: *This study aims to explore the antecedents of new product development (NPD) success rising innovative work behavior and team reflexivity as the mediators. A research model was developed and empirical validations of this model was confirmed.*
Design/methodology/approach: *This study used quantitative study with questionnaire approach to collect the data. The respondents are 41 teams which consist of team leaders and team members from various companies. SPSS software and Smart PLS software was used to analyze the results.*
Findings: *Based on content analysis, this study developed the research framework of NPD team success. The antecedents of NPD success are regulatory focus, project orientation, and task familiarity which affected NPD success through innovative work behavior and team reflexivity. The quantitative result indicates that regulatory focus has significant relationship with innovative work behavior; project orientation and task familiarity has a positive relationship with team reflexivity; innovative work behavior and regulatory focus have significant relationship to the NPD success.*
Research limitation/implications: *The main limitation of this study is that the respondents come from various industries which may results in bias. The comprehensive research framework that developed in this study can be guidance and benchmark for future research. In practice, team leader can get deep understanding about the main factors of NPD success in order to improve their NPD performance.*
Originality/value: *This study developed a comprehensive research framework and ten research hypotheses of NPD success that can be very useful for future focus.*

Keywords: regulatory focus, project orientation, task familiarity, innovative work behavior, team reflexivity, NPD success
Paper type: Research paper

INTRODUCTION

New product success has been an important issue in new product development (NPD) research. Griffin (1997) reports that the average success rate of NPD in USA was 59% and 100 ideas lead to 15.2 successful new products. Ozer and Chen (2006) reports that the success rate of NPD in Hong Kong is 44.91% and 100 ideas only lead to 2.15 successful new products.

Currently, organizations are increasingly relying on teams to innovate and respond to the rapidly changing marketplace (e.g., West, 2002). In other words, an organization needs to maintain and strengthen their NPD teams if they are going to innovate (e.g., Tjosvold,

1991). This study regards team's ability for being reflexive (West, 1996, 2002) as a crucial element to transform the members' knowledge and skills into innovative products. In addition, this study asserts that team reflexivity determined by members' project management skills (Hoegl and Parboteeah, 2006). The skills are necessary for flexible planning and ongoing controlling of the task process, which is of particular importance in the case of innovative projects, since it has high degree of task-related uncertainty and complexity. Moreover, NPD teams will have capability to be reflexive when they have adequate knowledge on certain issues related with the newly developed product. Refer to Brockman and Morgan (2006), team members' knowledge is critical to determine the quality of reflexivity of the team. When the members' have adequate level of knowledge and project skills, team's reflection could generate innovative ideas.

This study proposes that project orientation also determines the level of team reflexivity, either customer- or competitor-related orientation (Kohli and Jaworski, 1990 and Homburg et al., 2007). Based on above discussion, this study considers five variables as determinants of NPD success which are regulatory focus, project orientation, task familiarity, innovative work behaviors and team reflexivity. This study argues that NPD team members' intentional introduction or application of new ideas, products, processes, and procedures to their team (West and Farr, 1989, 1990b; Yuan and Woodman, 2010) also will facilitate the success of NPD. Despite proposing ideas from the team members, innovative work behaviors also includes the ability to adopt others' ideas that are new to one's organization or work unit (Woodman et al., 1993). Similar to the antecedents of team reflexivity, this study proposes that members' innovative behaviors are determined by regulatory focus, project orientation, and task familiarity that NPD teams had.

As a consequences, there are four research objectives of this study. First, to examine the antecedents and consequences of innovative work behaviors and team reflexivity inside NPD teams. Second, to investigate the effect of project orientation, regulatory focus and task familiarity on team reflexivity. Third, to investigate the effect of project orientation, regulatory focus and task familiarity on innovative work behavior. Fourth, to investigate the effect of project orientation, regulatory focus and task familiarity on NPD success.

LITERATURE REVIEW

Definition of Construct

1. Project Orientation

This study identify project orientation based on the concept of market orientation (e.g., Kohli and Jaworski, 1990; Narver and Slater, 1990). According to Narver and Slater (1990) market orientation is "the organization culture that most effectively and efficiently creates the necessary behaviors for the creation of superior value for buyers and, thus, continuous superior performance for the business" (p.3). According to Homburg, Grozdanovic, and Klarmann (2007), responsiveness is typically a main facet of market orientation. They further proposed that there are two different kinds of responsiveness: "customer-related responsiveness is the extent to which an organization responds quickly to customer- related changes, and… competitor-related responsiveness is the extent to

which an organization responds quickly to competitor-related changes" (Homburg et al., 2007, p. 19). Based on that, this study adopts both customer-related and competitor-related responsiveness. This study asserts that timely responses to customer-related changes and competitor-related changes will result in many beneficial consequences for NPD teams.

2. Team Reflexivity

According to West (1996, 2000, 2002), there are three central elements to the concept of reflexivity—reflection, planning, and action or adaptation. Reflection consists of attention, awareness, monitoring, and evaluation of the object of reflection. Planning is one of the potential consequences of the indeterminacy of reflection, since during this indeterminacy, the courses of action can be contemplated, intentions formed, plans developed (in more or less detail), and the potential for carrying them out is built up. High reflexivity exists when team planning is characterized by greater detail, inclusiveness of potential problems, hierarchical ordering of plans, and long as well as short range planning. The more detailed the implementation plans, the greater the likelihood that they will manifest in innovation (Frese and Zapf, 1994; Gollwitzer, 1996). Indeed the work of Gollwitzer and colleagues suggests that innovation will be implemented almost only when the team has articulated implementation intentions. This is because planning creates a conceptual readiness for, and guides team members' attention towards relevant opportunities for action and means to implement the innovation. Action refers to goal-directed behaviors relevant to achieving the desired changes in team objective, strategies, processes, organizations, or environments identified by the team. In a variety of studies links between reflexivity and team innovation and effectiveness have been demonstrated (Carter and West, 1998; West, Patterson, and Dawson, 1999; Borrill *et al.*, 2000). This study uses these dimensions - reflection, planning, and action or adaptation – to represents the team reflexivity which can influence the product innovativeness of NPD teams' resulted as well as the new product performance.

3. Innovative Work Behaviors

Drawing on West and Farr (1989, 1990b), Yuan and Woodman (2010) define innovative behavior as an employee's intentional introduction or application of new ideas, products, processes, and procedures to his or her work role, work unit, or organization. Examples of such behavior include searching out new technologies, suggesting new ways to achieve objectives, applying new work methods, and investigating and securing resources to implement new ideas. In keeping with Kanter (1988), Janssen (2000), and Scott and Bruce (1994), this study asserts that innovative behavior as complex behavior consisting of activities pertaining to both the generation/introduction of new ideas (either by oneself or adopted from others) and the realization or implementation of new ideas. One related construct in the literature is creative behavior, which refers to behavior pertaining to the generation of ideas that are both novel and useful (Amabile, 1988; Oldham and Cummings, 1996). Creative behavior can be considered as one type of innovative behavior because innovative behavior includes not only generating novel ideas by oneself but also adopting others' ideas that are new to one's organization or work unit (Woodman et al., 1993). Also, creative behavior concerns new idea generation, whereas innovative behavior includes both the generation and implementation of new ideas (Shalley et al., 2004; Zhou, 2003).

4. Regulatory Focus

Specifically, Higgins (1997) proposed that people have two basic self-regulation systems. One regulates the achievement of rewards and focuses individuals on *promotion* goals, while the other regulates the avoidance of punishments and focuses individuals on *prevention* goals. Promotion goals represent the "ideal self" and include hopes, wishes, and aspirations, whereas prevention goals represent the "ought self" and include duties, obligations, and responsibilities.

The regulatory focus is determined both by situational and chronic factors (Higgins, 1997, 1998). Recent studies on prevention-promotion effects have suggested that the regulatory focus can be thought of as rich syndromes that differ from each other on multiple variables (Kluger, Stephan, Ganzach, and Hershkovitz, 2004; Van Dijk and Kluger, 2004). The basic motivations that underlie these two syndromes are two conflicting motivations: the motivation for stability versus the motivation for change. Both motivations are important for survival of the human being (Levontin, Kluger, and Van Dijk, 2004). According to this notion, the purpose of the prevention focus is to assure one's safety and security, to maintain routines, and to preserve the status quo. In contrast, the purpose of the promotion focus is to pursue development and change and to explore the advantage of creative and novel behaviors. Researchers have used regulatory focus theory to study goal attainment (e.g., Forster, Higgins, and Idson, 1998; Shah, Higgins, and Friedman, 1998), decision making (e.g., Crowe and Higgins, 1997), creativity (Friedman and Forster, 2001), information processing and persuasion (Aaker and Lee, 2001), and feedback and motivation (Forster, Grant, Idson, and Higgins, 2001; Van Dijk and Kluger, 2004). However, the theory has not been applied to the study of NPD.

5. Task Familiarity

The concept of familiarity in organizational teams has been defined as "the knowledge that members of a team have about the unique aspects of their work" (Goodman and Garber 1988), such as knowledge about the task itself and about other members of the team (Littlepage et al. 1997). As members work together over time, they become familiar with the task domain and with each other (Katz 1982), and they develop a common knowledge base through which team interaction and location of expert sources in the team can occur (Alavi and Leidner 2001). Task familiarity deals with the innovation , while team familiarity deals with incremental innovation. As discussed by Smith and Tushman (2005), exploration task familiarity is rooted in variance-increasing activities, learning by doing, and trial and error, while exploitation task familiarity is rooted in variance-decreasing activities and disciplined problem solving.

6. Outcomes

New product performance constitutes the very end of the innovation process (Perez Bustamante, 1999). New product performance has defined by Marsh and Stock (2006) as company's innovative capabilities, product quality, and efficiency of the firms on their new product. Song and Montoya-Weiss (1998) measures new product success as the degree to which a product met a firm's profit objectives. The vast majority of the studies suggest that being market oriented is associated with superior performance of

new-product success (e.g., Harmancioglu, McNally, Calantone, and Durmusoglu, 2007; Narver, Slater, and MacLachlan, 2004). Consistent with this stream of literatures, this study asserts that new product success can be assessed by market success of new product. Following Millson and Wilemon (2006), the market success is determined by four of new product success measurement as follows: (1) the degree to which a new product's profits exceeded or fell short of what is expected; (2) the degree to which sales exceeded or fell short of what is expected; (3) the degree to which a new product created a product category new to the firm; and (4) the degree to which a new product created a market that is new to the industry.

Hypotheses Development

1 The Determinants of Innovative Work Behaviors

Kark and Van Dijk (2007) indicate that the purpose of the promotion focus is to pursue development and change and to explore the advantage of creative and novel behaviors. Consequently, NPD team members will have greater willingness to perform innovative work behaviors when they have greater promotion focus. In contrast, members who operate primarily within the prevention focus are more concerned with duties and obligations, are likely to be sensitive to the presence or absence of punishments, and use avoidance as a goal attainment strategy (e.g., Crowe and Higgins, 1997; Friedman and Forster, 2001). Further, the purpose of the prevention focus is to assure one's safety and security, to maintain routines, and to preserve the status quo (Kark and Van Dijk, 2007). This study argues that members with prevention focus have less willingness to perform innovative work behaviors due to their avoidance attitude

NPD teams might have customer or competitor related responsiveness (Homburg et al., 2007). Either one, responsiveness of the NPD team members toward customer- or competitor-related changes will increase the innovative work behaviors from the members. In a product design firm, Sutton and Hargadon (1996) found that design engineers used brainstorming sessions as "prestige" or "status auctions"—that is, as opportunities to impress their peers and establish favorable social images. Thus, when NPD teams have customer or competitor related responsiveness, the members will tend to introduce innovative ideas in order to impress each other. Therefore, the following hypothesis is developed:

Hypothesis 1. Regulatory focus has positive influence on innovative work behavior
Hypothesis 2. Project orientation has positive influence on innovative work behavior

2 The Determinants of Team Reflexivity

Customer orientation echoes the classic tenet of 'stay close to the customer' and 'put the customer at the top of the organizational chart' and therefore is the most essential part of a market orientation (Peters and Austin, 1985; Deshpande´ and Farley, 1998). Consequently, the NPD team needs to be more reflexive on any changes related with their customers. On the other hand, competitor orientation focuses on the strengths and weaknesses of its competitors (Deshpande´ et al., 1993; Armstrong and Collopy, 1996). To response on any actions being taken by its competitors, NPD team also need to

be reflexive in order to overcome the thgreats posed by the competitors. In summary, Day and Wensley (1988) propose that customer and competitor orientations are two distinct approaches that lead to competitive advantage. A customer orientation, with its detailed analyses of customer needs and wants, helps a firm satisfy its customers better, and thus is more likely to lead to a differentiation advantage. In contrast, a competitor orientation may lead to a cost advantage because competitor-oriented businesses tend to watch costs closely, so they may quickly match the marketing initiatives of competitors. These advantages could be reach when the NPD teams are being reflexive toward their current tasks.

Harrison et.al. (2003) conjectured that the effects of familiarity on team performance may differ depending on the nature of the task itself. Similarly, Reagans et.al. (2005) also concluded that the task matters when studying the effects of familiarity. Their experimental study shows that team performance increased with task experience and decreased with task complexity. Performance on simpler tasks improved more strongly with task experience than on more complex tasks. Based on above descriptions, the following hypotheses are developed:

Hypothesis 3. Project orientation has positive influence on team reflexivity

Hypothesis 4. Task familiarity has positive influence on team reflexivity

3. The Effect of Team Reflexivity

Teams that engage in a complex processing (i.e., that are highly reflexive) will develop more innovations (ideas for new and improved ways of doing things or new products and services) than nonreflexive teams do (Hülsheger et al., 2009). The team reflexivity can make the team develop more innovation in the project. Furthermore, team reflexivity positively relates to higher levels of innovation and greater product performance (e.g., Carter & West, 1998; Tjosvold, et al., 2004). Reflexive teams are also likely to make better use of team members' expertise, thus achieving better project success due to greater awareness of their fellow team members' expertise and skills (Tjosvold, et al., 2004). From the results of previous research we conclude that team reflexivity plays an important role in determining the success of new product development. Based on above descriptions, the following hypothese are developed:

Hypothesis 5. Team reflexivity has positive influence on innovative work behavior.

Hypothesis 9. Team reflexivity has positive influence on NPD success.

4. The Effect of Innovative Work Behaviors

One of the major reasons people innovate in the workplace is to bring performance gains (Yuan and Woodman, 2010). This statement clearly states that there is a relationship between innovative work behaviour and performance gains. Expected performance outcomes are positive when employees believe that their innovative behaviors will bring performance improvement or efficiency gains for their work roles or work units, particularly in NPD teams (Yuan and Woodman, 2010). The innovative work behavior plays an important role in determining the sucess of the product development. Based on above descriptions, the

following hypothesis is developed:

Hypothesis 8. Innovative work behavior has positive influence on NPD success

5. The Effect of Regulatory Focus

Each regulatory focus has different consequences for perception, decision making, and emotions, as well as for individuals' behavior and performance (Higgins, 1997, 1998). Individuals who operate primarily within the promotion focus are more concerned with accomplishments and aspirations, are likely to be sensitive to the presence or absence of rewards, use approach as a goal attainment strategy, are more creative in problem-solving processes, show more willingness to take risks, and experience emotions ranging from elation and happiness to dejection (e.g., Brockner and Higgins, 2001; Crowe and Higgins, 1997; Friedman and Forster, 2001). In contrast, individuals who operate primarily within the prevention focus are more concerned with duties and obligations, are likely to be sensitive to the presence or absence of punishments, use avoidance as a goal attainment strategy, and experience emotions ranging from agitation or anxiety to quiescence or calmness.

The company which support the team by good promotion goals will be able to motivate the team members in doing their job. The purpose of the prevention focus is to assure one's safety and security, to maintain routines, and to preserve the status quo. In contrast, the purpose of the promotion focus is to pursue development and change and to explore the advantage of creative and novel behaviors. Based on above descriptions, the following hypothesis is developed:

Hypothesis 6. Regulatory focus has positive influence on NPD success.

6. The Effect of Task Familiarity

The concept of familiarity in organizational teams has been defined as "the knowledge that members of a team have about the unique aspects of their work" (Goodman and Garber 1988), such as knowledge about the task itself and about other members on the team (Littlepage et al. 1997). As members of a team work together over time, they become familiar with the task domain and with each other (Katz 1982), and they develop a common knowledge base through which team interaction and location of expert sources in the team can occur (Alavi and Leidner 2001). On the contrary, since exploitation task require NPD team to develop new product based on the existing product, thus, has higher familiarity with the tasks, and will able to produce a new product. Based on above descriptions, the following hypothesis is developed:

Hypothesis 7. Task Familiarity has positive influence on NPD success.

7. The Effect of Project Orientation

According to Homburg, Grozdanovic, and Klarmann (2007), responsiveness is typically a main facet of market orientation. They further propose that there are two different kinds of responsiveness: "customer-related responsiveness as the extent to which an organization responds quickly to customer- related changes, and… competitor-related responsiveness as the extent to which an organization responds quickly to competitor-related changes"

(Homburg et al., 2007, p. 19). This study asserts that timely responses to customer-related changes and competitor-related changes have several beneficial consequences for NPD. Based on above descriptions, the following hypothesis is developed:

Hypothesis 10. Project orientation has positive influence on NPD success.

RESEARCH METHODOLOGY

1. Research Model

Based on the above literature review and hypotheses development, this study develops a comprehensive research framework as shown in Figure 1. As shown in the framework, NPD success are influenced by regulatory focus, project orientation, task familiarity through NPD team reflexivity and innovative work behaviors. In this framework, innovative work and team reflexivity are served as two mediators that can facilitate the influences of the three antecedents on NPD success.

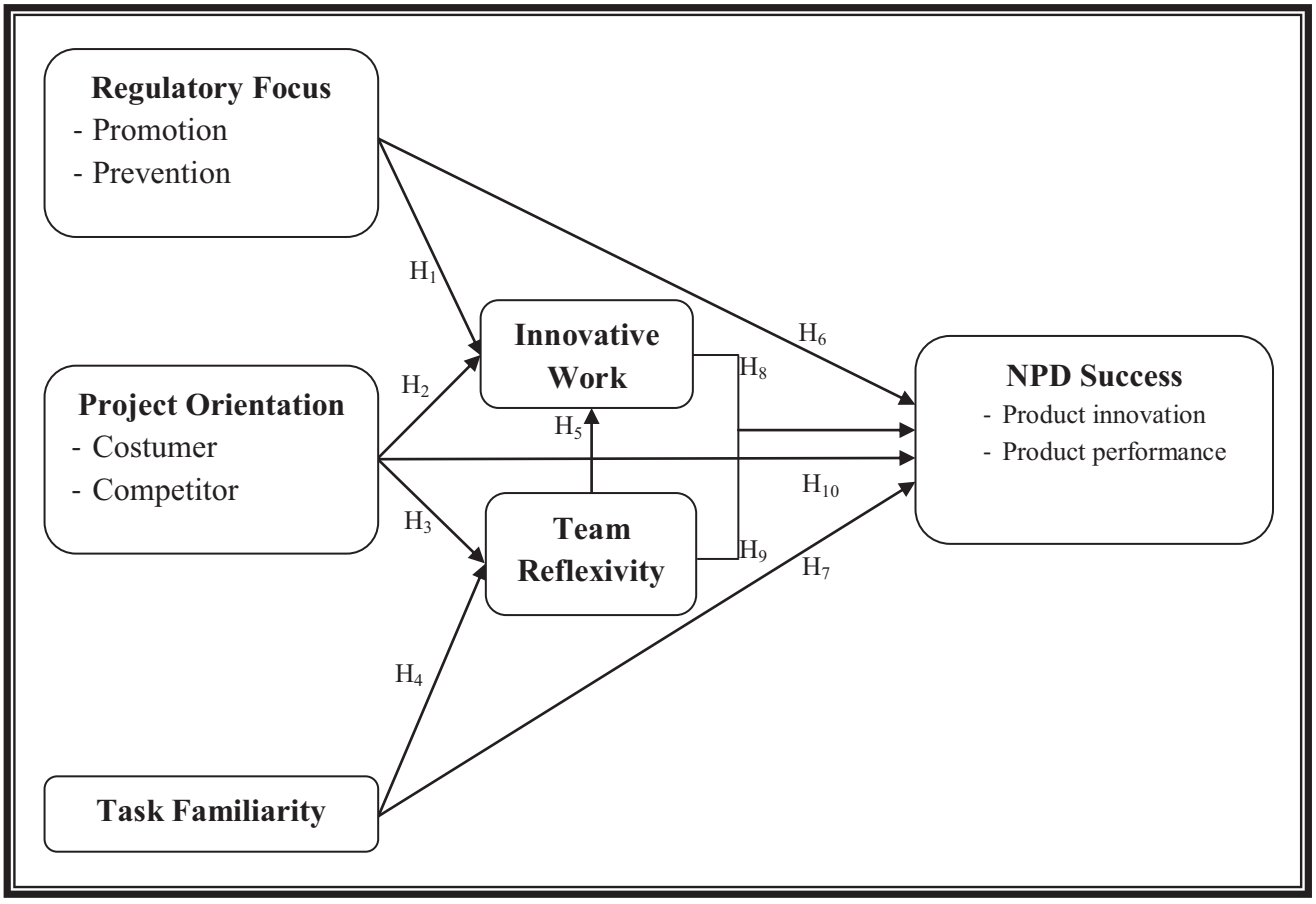


Figure 1 : Research Framework

2. Measurement of Construct

Survey questionnaire items were designed based on the review of literature. Some potential questionnaire items are listed below:

1. *Regulatory Focus.*
   This study adopted RFQ items from Higgins, Friedman, Harlow, Idson, Ayduk, and Taylor (2011) to measure regulatory focus based on their life history. All questionnaire items were measured on a 5-point Likert scale.
2. *Project Orientation.*
   This study adopted the items developed by Narver and Slater (1990) to measure the construct of project orientation. All the questionnaire items were measure on a 5-point Likert scale.
3. *Task familiarity.*
   This study employed items that modified from the existing knowledge developed by Moorman and Miner (1997) and Brockman and Morgan (2006). All the questionnaire items were measured on a 5-Likert rating scale.
4. *Innovative work behaviors.*
   This study employed six items of innovative work behaviors as developed by Scott and Bruce (1994) and further adopted by Yuan and Woodman (2010). All the questionnaire items were measured on a 5-Likert rating scale.
5. *Team reflexivity,*
   The questionnaire items of team reflexivity were adopted from Hoegl and Parboteeah (2006). All the questionnaire items were measured on a 5-Likert rating scale.
6. *NPD Success*
   The questionnaire items of product innovation were adopted from Jordan and Segelod (2006) and product innovation were adopted from Copper and Kleinschmidt (1987), and Akgun et al. (2006).

3 Sampling Design and Data Collection

In both, online and offline questionnaire surveys were conducted in this study. Forty one R&D teams of new product development (NPD) were selected. For each NPD team, there are one team leader and four team members that answer our questionnaire items.

Table 1. Demographic characteristics of respondents

Characteristic		Number	Percent
Gender	Male	147	72%
	Female	58	28%
Marriage	Single	115	56%
	Married	90	44%
Age	Less than 25	61	30%
	26-35	72	35%
	36-45	43	21%
	46-55	25	12%
	More than 55	4	2%
Education	Bachelor degree	111	54%
	Master degree	85	41%
	Doctoral degree	9	4%
Working experience	Less than 5 years	82	40%
	6-10 years	66	32%
	11-15 years	30	15%
	More than 16 years	27	13%
Project Experience	Less than 5 years	128	62%
	6-10 years	51	25%
	11-15 years	13	6%
	More than 16 years	13	6%
Position	General Employee	120	59%
	Supervisor	40	20%
	Lower-level manager	19	9%
	Middle-level manager	13	6%
	Top Manager	13	6%
Position in NPD team	Leader	41	20%
	Member	164	80%
Type of industry	Traditional industries	53	26%
	High-tech manufacturing industry	61	30%
	Other	91	44%

A total of 205 respondents from Indonesia and Taiwan participate in the survey. The survey material includes a cover letter from researcher and university-addressed. Respondents were asked to express their opinions about their project orientation, team reflexivity, task familiarity innovative work behaviors, and NPD success. Respondents were promise to complete anonymity of any information that they submitted.

For each NPD team, the team leader in the high-tech firms in Taiwan and Indonesia were asked to participate in the survey. The survey questionnaires were sent to the leaders and members of representative NPD teams

4 Construct Reliability and Validity

The final versions of the survey questionnaire items were refined through a process of purification including factor analysis, item-to-total correlation, and Cronbach's alpha. A total 205 respondents from 41 NPD teams of firms were participated this study. The

members were asked to express their perception toward regulatory focus, project orientation, task familiarity. While the items related with team reflexivity, innovative work behaviors, NPD success, and firm performance were responded by team leaders. In order to achieve the purposes of this study and to test the research hypotheses, SPSS and Smart PLS software were employed to analyze the collected data.

To purify the measurement scales of each research construct and to identify their dimensionality, principal components factor analysis with varimax rotation were applied to condense the collected data from a number of variables into a few factors. After conducting factor analysis, item-to-total correlation and internal consistency analysis were employed to confirm the reliability of each factors. Result of the factor analysis are presented in table 2. As shown, all factor loadings were higher than 0.6 with eigenvalue is higher than 1. The *item-to-total correlation* for all variables were higher than 0,5 and Cronbach's alpha higher than 0.6, suggest higher internal consistency for all variables.

Table 2. Result of Factor Analysis

Research Construct	Research Item	Factor Loading	Eigenvalue	Accumulative Explanation %	Item-to-Total Correlation	Cronbach's α
Regulatory Focus	**Promotion Focus**		3.259	35.064		0.794
KMO=0.771 Barlett=0.000	RF7	0.835			0.617	
	RF3	0.772			0.525	
	RF6	0.725			0.654	
	RF5	0.720			0.626	
	Prevention Focus		1.504	68.048		0.806
	RF8	0.880			0.699	
	RF9	0.834			0.637	
	RF11	0.769			0.636	
Project Orientation	**Costumer Orientation**		3.693	61.548		0.874
KMO=0.814 Barlett=0.000	PO5	0.820			0.722	
	PO3	0.808			0.707	
	PO2	0.795			0.691	
	PO4	0.785			0.677	
	PO6	0.761			0.650	
	PO1	0.735			0.621	
	Competitor Orientation		2.198	73.280		0.817
	PO8	0.892			0.733	
	PO7	0.854			0.669	
	PO9	0.820			0.615	
Task Familiarity	**Task Familiarity**		2.816	70.402		0.858
KMO=0.767 Barlett=0.000	TF2	0.866			0.741	
	TF1	0.848			0.710	
	TF3	0.827			0.692	
	TF4	0.815			0.674	
Team Reflexivity	**Team Reflexivity**		4.253	53.164		0.871
KMO=0.827 Barlett=0.000	TR9	0.806			0.725	
	TR6	0.796			0.709	
	TR5	0.751			0.650	
	TR7	0.747			0.653	

Research Construct	Research Item	Factor Loading	Eigenvalue	Accumulative Explanation %	Item-to-Total Correlation	Cronbach's α
	TR8	0.703			0.598	
	TR2	0.697			0.595	
	TR1	0.679			0.577	
	TR4	0.637			0.532	
Innovative Work Behavior	**Innovative Work Behavior**		4.023	67.049		0.900
KMO=0.885 Barlett=0.000	IWB6	0.872			0.801	
	IWB5	0.861			0.788	
	IWB1	0.821			0.729	
	IWB4	0.793			0.701	
	IWB2	0.782			0.683	
	IWB3	0.778			0.684	
NPD Success	**Product Innovation**		3.587	71.736		0.893
KMO=0.813 Barlett=0.000	NS4	0.890			0.813	
	NS3	0.869			0.794	
	NS2	0.869			0.764	
	NS1	0.861			0.755	
	NS5	0.736			0.621	
	Product Performance		3.597	71.947		0.902
	NS7	0.891			0.815	
	NS6	0.874			0.791	
	NS8	0.866			0.778	
	NS10	0.831			0.734	
	NS9	0.774			0.665	

RESULTS AND DISSCUSSIONS

The research results are displayed in Figure 2. Each latent variable is related to one or more manifest variables that are measured. For example, for the task familiarity (TF) latent variable the four manifest variables are:

a. A great deal of information about this product category (TF1)
b. A great deal of knowledge about this product category (TF2)
c. A strong understanding of this product category (TF3)
d. A great deal of insight regarding this product category (TF4)

There are total of six latent variable with its own manifest variable in this framework. There are also ten hypotheses among the latent variable.

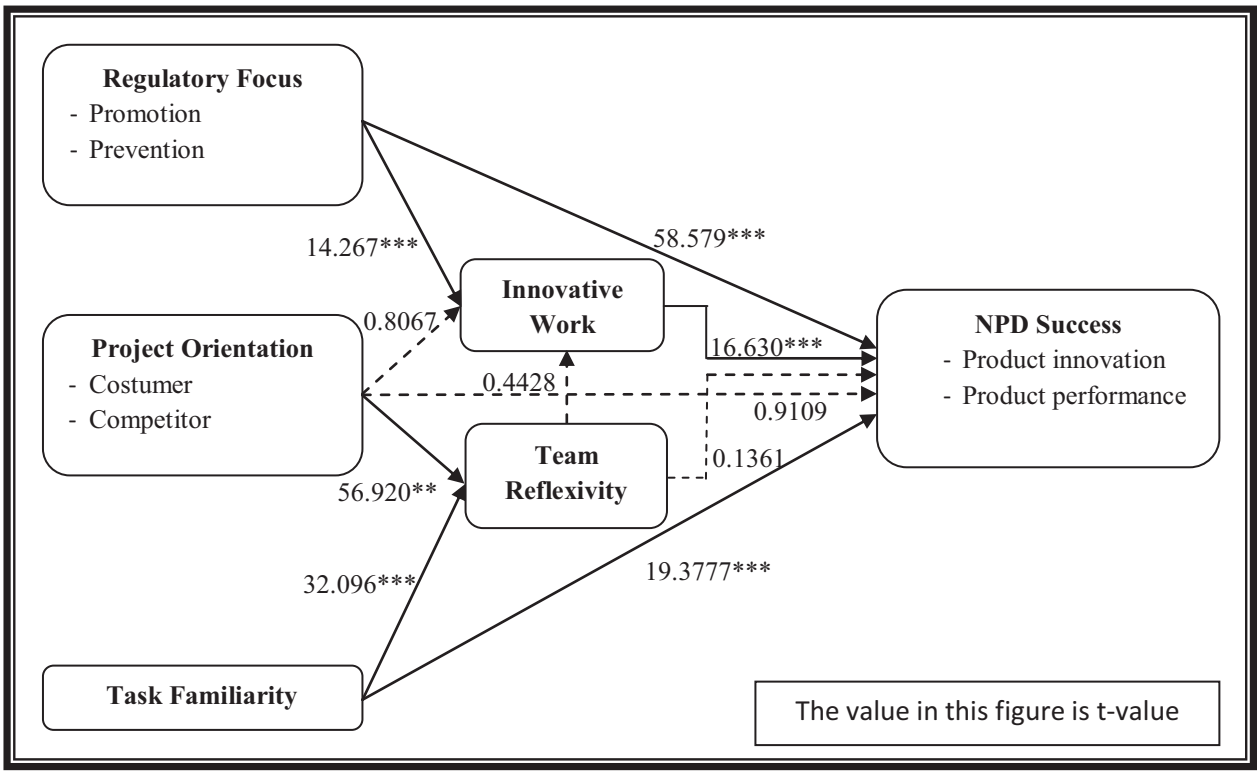


Table 3. Overview Result of Partial Least Square

	AVE	Composite Reliability	R Square	Communality
IWB	0.6540	0.9186	0.0300	0.6540
NS	0.8863	0.9397	0.3823	0.8863
PO	0.8540	0.9213	0.0000	0.8540
RF	0.6980	0.8220	0.0000	0.6980
TF	0.7030	0.9044	0.0000	0.7030
TR	0.5275	0.8990	0.4476	0.5275

There are ten hyphotheses in this study with 205 samples consist of 41 team leaders and 164 team members of various company. SmartPLS software was used to test the hypotheses. The result of SmartPLS is provided in Table 4.

a. The determinants of innovative work behavior (hypothesis 1 and 2)
   Table 4 shows that regulatory focus has negative effect (β=-0.1554; $p<0.01$) on innovative work behavior and project orientation has no effect on innovative work behavior ((β=-0.0612; $p>0.01$). This result is contrast with Higgins (2001) that stated the company which support the team by good promotion goals will be able to motivate the team members in doing their job. Furthermore, Sutton and Hargadon (1996) stated that NPD teams which have knowledge of project orientations will tend to introduce the innovative ideas. Therefore, it can be concluded that hypothesis 1 and 2 are not supported.

b. The determinants of team reflexivity (hypothesis 3 and 4)
From table 4, we can see that both project orientation (β=0.4797; p<0.01) and task familiarity (β=0.2756; p<0.01) have positive effect on team reflexivity. This result is in line with Zhou, Brown, Dev, and Agarwal (2007) which states that project orientation places the highest priority on creating and maintaining superior customer value, and provides firm-wide norms and beliefs that guide organizational behaviors. Furthermore, Espinosa et al. (2007) states that familiarity can improve team performance. Thus, it can be concluded that hypothesis 3 and 4 are supported.

c. The effect of team reflexivity (hypothesis 5 and 9)
Table 4 shows that team reflexivity has no effect on innovative work behavior (β=0.612; p>0.01) and NPD success (β=-0.0047; p>0.01). This result is contrast with Hülsheger et al. (2009) which state that the team which engage in a complex processing (i.e., Highly reflexive) will develop more innovations (new ideas, new ways of doing job, or new products and services) than non-reflexive teams do. Furthermore, team reflexivity positively relates to higher levels of innovation and greater product performance (e.g., Carter & West, 1998; Tjosvold, et al., 2004). Therefore, it can be concluded that hypothesis 5 and 9 are not supported.

d. The effect of regulatory focus, task familiarity, project orientation and innovative work behavior on NPD success (hypothesis 6, 7, 8, and 10)
From table 4, we can see that regulatory focus (β=0.4935; p<0.01), team reflexivity (β= 0.1540; p<0.01), and innovative work behavior (β= 0.1310; p<0.01) have positive effect on NPD success. This result is in line with Yuan and Woodman (2010) that the expected performance outcomes are positive when employees believe that innovative behaviors will improve their performance or efficiency gains for their work roles or work units, particularly in NPD teams. Higgins (2010) state that the company which support the team by good promotion goals will be able to motivate the team members in doing their job. Furthermore, Alavi and Leidner (2001) state that since exploitation task require NPD team to develop new product based on the existing product, thus, with higher familiarity with the tasks, will able to produce a new product. But, project orientation (β=0.0660; p>0.01) has no effect on NPD success. This result is contrast with Homburg et al. (2007) who asserts that timely responses to customer-related changes and competitor-related changes will have beneficial consequences for NPD success. Therefore, it can be concluded that hypothesis 6, 7, and 8 are supported but hypothesis 10 is not supported.

e. The mediating effect of innovative work behavior and team reflexivity
According to figure 2, first, we can conclude that the effect of regulatory focus on NPD success is partially mediated by innovative work behavior because regulatory focus has direct and indirect effect on NPD success. Second, innovative work behavior is fully mediating the effect of project orientation on NPD success. Third, team reflexivity has no mediation effect on both the effect of project orientation and task familiarity on NPD success.

CONCLUSIONS AND SUGGESTION

This study attempts to explore the antecedents of new product development (NPD) success. Based on extensive literature reviews and quantitative study using SPSS and SmartPLS as the analytical tools, this study found the following results. Firstly, five essential elements that might contribute to the NPD success were identified. These elements include regulatory focus, project orientation, task familiarity, innovative work behaviour, and team reflexivity. Second, both regulatory focus and project orientation have a influence on innovative work behavior. Third, project orientation and task familiarity has a positive relationship with team reflexivity. The quantitative results show these two variables have a

Table 4. Result of Partial Least Square (PLS)

Relations		Standardized Coefficients	C.R.
Variables			
Regulatory Focus (RF)	Pro_m	0.8072	84.739***
	Pre_m	0.8628	89.338***
Project Orientation(PO)	Con_m	0.9226	197.090***
	Com_m	0.9256	221.631***
Task Familiarity (TF)	Tf1	0.8619	131.555***
	Tf2	0.8619	123.156***
	Tf3	0.8094	100.829***
	Tf4	0.8191	98.228***
Innovative Work Behavior (IWB)	Iwb1	0.7609	0.8033
	Iwb2	0.7074	0.5086
	Iwb3	0.8228	21.325***
	Iwb4	0.8616	20.940***
	Iwb5	0.8454	17.304***
	Iwb6	0.8428	16.457***
Team Reflexivity (TR)	Tr1	0.7196	91.309***
	Tr2	0.7445	87.865***
	Tr4	0.6645	86.052***
	Tr5	0.6997	52.757***
	Tr6	0.7721	85.601***
	Tr7	0.7280	88.096***
	Tr8	0.6821	73.280***
	Tr9	0.7911	103.691***
NPD Success (NS	Inn_m	0.9373	165.737***
	Per_m	0.9544	172.398***
Path			
RF → IWB (H1)		-0.1554	14.267***
PO → IWB (H2)		-0.0612	0.8067
PO → TR (H3)		0.4797	56.920***

TF → TR (H4)	0.2756	32.096***
TR → IWB(H5)	0.612	0.4428
RF→ NS (H6)	0.4935	58.579***
TF→ NS (H7)	0.1540	19.377***
IWB → NS (H8)	0.1310	16.630***
TR → NS(H9)	-0.0047	0.1361
PO→ NS (H10)	0.0660	0.9109

Note : Critical t-values for a two-tailed test are 1.65 (significance level = 10 percent), 1.96 (significance level = 5 percent), and 2.58 (significance level = 1 percent).

significant and positive impact on team reflexivity. This results further confirm that a more clear project orientation and a higher task familiarity will result in higher team reflexivity.

Fourth, the quantitative results show that innovative work behavior and regulatory focus have significant relationship to NPD success, while the task familiarity and project orientation and have no significant relationship to NPD success.

Fifth, path of regulatory focus to NPD success is partially mediating by innovative work behavior and path of project orientation to NPD success is fully mediating by innovative work behavior. Furthermore, team reflexivity can not be a mediating variable for both of project orientation and task familiarity because the path of team reflexivity to NPD success is not significant.

Finally, this reaserach promises to contribute our understandings of NPD practices by developing comprehensive model that encompassed the antecedents and consequences of team reflexivity and innovative work behaviors. The antecedents include regulatory focus, project orientation and task familiarity. The three antecedents are proposed to be mediated by team reflexivity and innovative work behaviors before having effects on NPD success. This study has aimed to develop comprehensive sources of NPD team reflexivity and innovative work behaviors by proposing that regulatory focus, project orientation, and task familiarity as the determinants. The results can enhance understanding on the role of these antecedents on NPD team operations. This study has aimed to extend the concept of innovative work behaviors as the phenomenon inside NPD teams that will contribute to members', teams, and organizational outcomes. This study further argues that members will have innovative work behaviors when the team has sufficient time to reflect their current assignment. Thus, the results of this study can provide valuable information for NPD management and for further academic validation.

REFERENCES

1. Aaker, J. L., and Lee, A. Y. (2001). "I" seek pleasures and "we" avoid pains: The role of self-regulatory goals in information processing and persuasion. Journal of Consumer Research, 28, 33–49.
2. Alavi, M., D. E. Leidner. (2001). Knowledge management and knowledge management systems: Conceptual foundations and research issues. MIS Quarterly, 25(1), 107–136.
3. Alegre, J., Sengupta, K., and Lapiedra, R. (2011). Knowledge management and

innovation performance in a high-tech SMEs industry. International Small Business Journal, 1–17.
4. Amabile, T. M. (1988). A model of creativity and innovation in organizations. In B. M. Staw and L. L. Cummings (Eds.), Research in organizational behavior, 10, 123–167.
5. Amason, A. C. (1996). Distinguishing the effects of functional and dysfunctional conflict on strategic decision making: Resolving a paradox for top management groups. Academy of Management Journal, 39, 123-148.
6. Amason AC, Schweiger D. (1997). "The effect of conflict on strategic decision making effectiveness and organizational performance." In C. K. W. De Dreu and E. Van de Vliert (Eds.), Using Conflict in Organizations: 101-115. London: Sage.
7. Borrill, C. S., Carletta, J., Carter, A. J., Dawson, J., Garrod, S., Rees, A., et al. (2000). The effectiveness of health care teams in the national health service. Birmingham: Aston Centre for Health Service Organization Research.
8. Brockman, B. K., and Morgan, R. M. (2006). The moderating effect of organizational cohesiveness in knowledge use and new product development. Journal of the Academy of Marketing Science, 34(3), 295-307.
9. Brockner, J., and Higgins, T.E. (2001). Regulatory focus theory: Implications for the study of Emotions at work. Organizational Behaviour and Human Decision Processes, 86, 35-66.
10. Carter, S. M., and West, M. A. (1998). Reflexivity, effectiveness, and mental health in BBC-TV production teams. Small Group Research, 29, 583-601.
11. Colquitt, J. A., Conlon, D. E., Wesson, M. J., Porter, C., and Ng, K. Y. (2001). Justice at the millennium: A meta-analytic review of 25 years of organizational justice research. Journal of Applied Psychology, 86, 425–445.
12. Cooper, R. G., and Kleinschmidt, E. J. (1987). New products: What separates winners from losers? Journal of Product Innovation Management, 4, 169-184.
13. Crowe, E., and Higgins, E. T. (1997). Regulatory focus and strategic inclinations: Promotion and prevention in decision-making. Organizational Behavior and Human Decision Processes, 69, 117-132.
14. De Dreu CKW, Weingart LR. (2003). Task versus relationship conflict, tem performance, and team member satisfaction: A meta- analysis. Journal of Applied Psychology, 88(4), 741-749.
15. Dyer, W. G., and Page, R. A., Jr. (1988). The politics of innovation. Knowledge in the Society: An International Journal of Knowledge Transfer, 1(2), 23–41.
16. Forster, J., Higgins, E. T., and Idson, L. C. (1998). Approach and avoidance strength during goal attainment: Regulatory focus and the "goal looms larger" effect. Journal of Personality and Social Psychology, 75, 1115–1131.
17. Forster, J., Grant, H., Idson, L. C., and Higgins, E. T. (2001). Success/failure feedback, expectancies, and approach/avoidance motivation: How regulatory focus moderates classic relations. Journal of Experimental Social Psychology, 37, 253–260.
18. Forsyth D. (1983). An Introduction to Group Dynamics. Monterey, CA: Brooks/Cole.
19. H. C. Triandis, M. D. Dunnette and L. M. Hough (Eds.), Handbook of industrial and organizational psychology (Vol. 4, pp. 271-340). Palo Alto, CA: Consulting Psychologists Press.
20. Friedman, R., and Förster, J. (2001). The effects of promotion and prevention cues on creativity. Journal of Personality and Social Psychology, 81, 1001-1013.
21. Gladstein, D. L. (1984). Groups in context: A model of task group

effectiveness. Administrative Science Quarterly, 29, 499-517.
22. Goldenberg, J., Lehmann, D.R. and Mazursky, D. (1999) The primacy of the idea itself as a predictor of new product success. Report 99–110. Cambridge, MA: Marketing Science Institute.
23. Gollwitzer, P. M. (1996). The Volitional Benefits of Planning. In P. M. Gollwitzer and J. A. Bargh (Eds.), The psychology of action: Linking cognition and motivation to behaviour (pp. 287-312). New York: Guilford Press.
24. Goodman, P.S., Garber, S. (1988). Absenteeism and accidents in a dangerous environment: Empirical analysis of underground coal mines. Journal of Applied Psychology, 73(1), 81–86.
25. Gray, J. A. (1982). The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system. New York: Oxford University Press.
26. Harmancioglu, N., McNally, R. C., Calantone, R. J., and Durmusoglu, S. S. (2007). Your new product development (NPD) is only as good as your process: an exploratory analysis of new NPD process design and implementation. R&D Management, 37(5), 399–424.
27. Higgins, E. T. (1998). Promotion and prevention: Regulatory focus as a motivational principle. In M. P. Zanna (Ed.), Advances in Experimental Social Psychology (Vol. 30, pp. 1–46). New York: Academic Press.
28. Hoegl, M., and Parboteeah, K. P. (2006). Team reflexivity in innovative projects. R&D Management, 36(2), 113-125.
29. Homburg, C., Grozdanovic, M., and Klarmann, M. (2007). Responsiveness to customers and competitors: The role of affective and cognitive organizational systems. Journal of Marketing, 71(3), 18–38.
30. Hülsheger, U. R., Anderson, N., & Salgado, J. F. (2009). Team-level predictors of innovation at work: A comprehensive meta-analysis spanning three decades of research. Journal of Applied Psychology, 94, 1128-1145.
31. Jehn K (1995). A multimethod examination of the benefits and detriments of intragroup conflict. Administrative Science Quarterly, 40, 256–282.
32. Jehn K (1997). “Affective and cognitive conflict in work groups: Increasing performance through value-based intragroup conflict.” In C. K. W. De Dreu and E. Van de Vliert (Eds.), Using conflict in organizations (pp. 87–100). London: Sage.
33. Johnson, D. W., Johnson, R., Stanne, M., and Garibaldi, A. (1990). Impact of group processing on achievement in cooperative groups. Journal of Social Psychology, 130, 507-516.
34. Jordan, G., and Segelod, E. (2006). Software innovativeness: Outcomes on project performance, knowledge enhancement, and external linkages. R&D Management, 36(2), 127-142.
35. Kanter, R. M. (1988). When a thousand flowers bloom: Structural, collective, and social conditions for innovation in organization. In B. M. Staw and L. L. Cummings (Eds.), Research in Organizational Behavior, vol. 10: 169–211. Greenwich, CT: JAI Press.
36. Katila, R. and Ahuja, G. (2002). Something old, something new: A longitudinal study of search behavior and new product introduction. The Academy of Management Journal, 45(6), 1183-1194.
37. Keskin, H. (2009). Antecedents and consequences of team memory in software development projects. Information & Management, 46, 388-396.
38. Kluger, A. N., Stephan, E., Ganzach, Y., and Hershkovitz, M. (2004). The effect of

regulatory focus on the shape of probability-weighting function: Evidence from a cross-modality matching method. Organizational Behavior and Human Decision Processes, 95(1), 20-39.
39. Kohli, A. K., and Jaworski, B. J. (1990). Market orientation: The construct, research propositions, and managerial implications. Journal of Marketing, 54(July), 1–18.
40. Lee, L. T. S. (2008). The effects of team reflexivity and innovativeness on new product development performance. Industrial Management & Data Systems, 108(4), 548-569.
41. Lee, L. T. S. and Sukoco, B. M. (2011). Risk-taking as a moderator of the effect of team reflexivity on product innovation: An empirical study. International Journal of Management, 28(4).
42. Lee, L. T. S. and Sukoco, B. M. (2011). Reflexivity, stress, and unlearning in the new product development team: the moderating effect of procedural justice. R&D Management, 41(4), 410-423.
43. Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. Strategic Management Journal, 13(8), 111-125.
44. Levontin, L., Kluger, A., and Van Dijk, D. (2004). Goal-orientation theory and regulatory-focus theory: The "conflicting" effects of feedback- sign. Working paper, Hebrew University of Jerusalem.
45. Li, H. Y., Bingham, J. B. and Umphress, E. E. (2007) Fairness from the top: perceived procedural justice and collaborative problem solving in new product development. Organization Science, 18, 200–216
46. Lickel, B., Hamilton, D. L., and Sherman, S. J. (2001). Elements of a lay theory of groups: Types of groups, relational styles, and the perception of group entitativity. Personality and Social Psychology Review, 5, 129-140.
47. Lind, E. A., and Tyler, T. R. (1988). The social psychology of procedural justice. Plenum Press, New York.
48. Littlepage, G., W. Robison, K. Reddington. 1997. Effects of task experience and group experience on group performance, member ability, and recognition of expertise. Organizational Behavior and Human Decision Processes, 69(2), 133–147.
49. Lum, L., Kervin, J., Clark, K., Reid, F., and Sirola, W. (1998). Explaining nursing turnover intentions: job satisfaction, pay satisfaction, or organizational commitment? Journal of Organizational Behavior, 19, 305-320.
50. Luo, Y. (2008). Procedural fairness and interfirm cooperation in strategic alliances. Strategic Management Journal. 29, 27–46.
51. Luthans, F. (1989). Organisational behaviour, New York, McGraw-Hill, 5th edition, pp 176–185, 264–283.
52. Marsh, S.J., Stock, G.N. (2006). Creating dynamic capability: the role of intertemporal integration, knowledge retention, and interpretation. Journal of Product Innovation Management, 23(5), 422-36.
53. Millson, M.R. and Wilemon, D. (2006). Driving new product success in the electrical equipment manufacturing industry. Technovation, 26, 1268–1286.
54. Moorman, C., and Miner, A. S. (1997). The impact of organizational memory on new product performance and creativity. Journal of Marketing Research, 34(1), 91-106.
55. Montoya-Weiss, M., and Calantone, R. (1994). Determinants of new product performance: A review and meta-analysis. Journal of Product Innovation Management, 11(5), 397-417.
56. Narver, J. C. and Slater, S. F. (1990). The effect of a market orientation on business profitability. Journal of Marketing, 54(4), 20-35.

57. Narver, J. C., Slater, S. F., and MacLachlan, D. L. (2004). Responsive and proactive market orientation and new-product success. Journal of Product Innovation Management, 21, 334–347
58. O'Cass, A. and Ngo, L. V. (2007). Market orientation versus innovative culture: two routes to superior brand performance. European Journal of Marketing, 41(7/8), 868-887.
59. Oldham, G. R., and Cummings, A. (1996). Employee creativity: Personal and contextual factors at work. Academy of Management Journal, 39, 607–634.
60. Perez-Bustamante, G. (1999). Knowledge management in agile innovative organizations. Journal of Knowledge Management. 3(1), 6–17.
61. Saleh, S. (1981). A structural view of job involvement and its differentiation from satisfaction and motivation. International Review of Applied Psychology, 30, 17–29.
62. Sanders, K., Moorkamp, M., Torka, N., Groeneveld, S., and Groeneveld, C. (2010). How to support innovative behaviour? The role of LMX and satisfaction with HR practices. Technology and Investment, 1, 59-68.
63. Sarwat, N., Hayat, K., Qureshi, J. A., and Ali, M. (2011). Impact of strategic leadership on organizational performance, in the context of job satisfaction and organizational commitment, evidence form educational institutions of Pakistan. Interdisciplinary Journal of Contemporary Research in Business, 3(4), 658-675.
64. Schippers, M. C., West, M. A., and Dawson, J. F. (2012). Team reflexivity and innovation: the moderating role of team context. Journal of Management.
65. Scott, S. G., and Bruce, R. A. (1994). Determinants of innovative behavior: A path model of individual innovation in the workplace. Academy of Management Journal, 37, 580–607.
66. Shah, S. K., and Corley, K. G. (2006). Building better theory by bridging the quantitative–qualitative divide. Journal of Management Studies. 43(8), 1821–1835.
67. Shalley, C. E., Zhou, J., and Oldham, G. R. (2004). The effects of personal and contextual characteristics on creativity: Where should we go from here? Journal of Management, 30, 933–958.
68. Slater, S. F., and Narver, J. C. (1995). Market orientation and the learning organization. Journal of Marketing, 59(3), 63-74.
69. Smith, W. K. and Tushman, M. L. (2005). Managing strategic contradictions: A top management model for managing innovation streams. Organization Science. 16 (5), 522–536.
70. Somech, A. (2006). The effects of leadership style and team process on performance and innovation in functionally heterogeneous teams. Journal of Management, 32(1), 132-157.
71. Song, M. X., and Montoya-Weiss, M. M. (1998). Critical development activities for really new versus incremental products Journal of Product Innovation Management, 15(2), 124-135.
72. Song, M. X., and Montoya-Weiss, M. M. (2001). The effect of perceived technological uncertainty on Japanese new product development. Academy of Management Journal, 44(1), 61-80.
73. Sun, L. Y. and Pan, W. (2011). Market orientation, intrapreneurship behavior, and organizational performance: Test of a structural contingency model. Journal of Leadership & Organizational Studies, 18(2), 274–285.
74. Sutton, S. K, and Davidson, R. J. (1997). Prefrontal brain asymmetry: A biological substrate of the behavioral approach and inhibition systems. Psychological

Science, 8, 204–210.
75. Tjosvold, D., Tang, M. M. L., and West, M. (2004). Reflexivity for team innovation in China: The Contribution of Goal Interdependence. Group & Organization Management, 29(5), 540.
76. Tjosvold, D., Hui, C., and Yu, Z. (2003). Conflict management and task reflexivity for team in-role and extra-role performance in China. International Journal of Conflict Management, 14(2), 141-163.
77. Tyler, T. R., and Lind, E. A. (1992). A relational model of authority in groups. M. P. Zanna, ed. Advances in Experimental Psychology. Academic Press, San Diego, CA, 115–191.
78. Van-Dijk, D., and Kluger, A. N. (2004). Feedback sign effect on motivation: Is it moderated by regulatory focus? Applied Psychology: An International Review, 53(1), 113-135.
79. Weerawardena, J. and O'Cass, A. (2004). Exploring the characteristics of the market-driven firms and antecedents to sustained competitive advantage. Industrial Marketing Management. Vol. 33. Issue 5. pp.419-28.
80. Weiss, H. M., and Cropanzano, R. (1996). Affective events theory: A theoretical discussion of the structure, causes and consequences of affective experiences at work. In B.M. Staw and L.L. Cummings (Eds.), Research in organizational behavior, 19, 1-74. Greenwich, CT: JAI Press.
81. West, M. A. (1996). The handbook of work group psychology. Chichester, UK: Wiley. West, M. A. (2000). Reflexivity, revolution and innovation in work teams. In M. Beyerlein (Ed.), Product development teams: Advances in interdisciplinary studies of work teams (pp. 1-30). Greenwich, CT: JAI.
82. West, M. A. (2002). Sparkling fountains or stagnant ponds: An integrative model of creativity and innovation implementation in work groups. Applied Psychology: An International Review, 51, 355-424.
83. West, M. A., Patterson, M. G., and Dawson, J. F. (1999). A path to profit? Teamwork at the top. Centrepiece, 4, 6-11.
84. West, M. A., and Farr, J. L. (1989). Innovation at work: Psychological perspectives. Social Behavior, 4, 15–30.
85. West, M. A., and Farr, J. L. (1990). Innovation at work. In M. A. West and J. L. Farr (Eds.), Innovation and creativity at work: Psychological and organizational strategies: 3–13. Chichester, U.K.: Wiley.

Authors' Detials:

1. **Les Tien-Shang Lee**, Professor, Department of International Trade, Graduate College of Management School of Business, Kun Shan University, No. 949, Da-Wan Rd., Yung Kang District, Tainan City, Taiwan 710, Phone: +886-6-2059928 ; email: llee321@mail.ksu.edu.tw

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

CONCEPTUALIZING PRODUCTIZATION FROM THE YIN YANG PERSPECTIVE

Tuomo Kinnunen, University of Oulu, Finland
Email: Tuomo.Kinnunen@oulu.fi

Harri Haapasalo, University of Oulu, Finland
Email: harri.haapasalo@oulu.fi

Kris M Y Law ,The Hong Kong Polytechnic University, Hong Kong
Email: mfkris@polyu.edu.hk

Kai Hanninen ,University of Oulu, Finland
Email: kai.hanninen@oulu.fi

ABSTRACT

Purpose: *In a modern competitive market, business quick decisions are often required at the point of sales to accommodate consumers' demands. New products demanded for fitting the latest portfolio are considered as new variations and sustainable product development is secured in the productization process. However, the scope of productization has not been clearly defined, while industry specifics should be taken into account. The existing situation lacks of a well agreed description of productization process, and it is in need of a well-structured model presenting the core aspects in the productization process, for better understanding and thus for better diagnosis and management. It is getting crucial to explore the practicality of presenting the productization process from a holistic manner.*
Design/Methodology: *The idea of The Yin Yang philosophy has been adopted to explain various phenomena in the reality, including contemporary management issues (Durlabhji, 2004). The five elements (cornerstones) rooted in the yin yang concept offers an opportunity to explain the productization process, while it implicitly implies on the nation of a dynamic balance between complementary forces.*
Findings: *This paper presents a conceptual model confining the productization process by incorporating the 'yin yang five elements' management concept. The model conceptualizes the relevant issues relating to the rapid productization process, and presents according to yin-yang five elements concept.*
Originality/Value: *The model presents the clear picture depicting the facilitating and opposing relationships of the five elements. The proposed conceptual model offers a good start for further study on the productization process, such as how it is affected by various factors, and how it can be managed effectively.*

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THREATS AND THE PROTECTION OF ELECTRONIC INFORMATION WITH REGARD TO SOCIAL NETWORKS

Matija Varga, mag. inf. univ. spec. oec. Media University, Croatia
maavarga@gmail.com

Red. prof. dr. sc. Vladimir Šimović Media University, Croatia
simovic.vladimir@yahoo.com

Doc. dr. sc. Marin Milković Media University, Croatia
dekan@velv.hr

ABSTRACT

The issues which appear today on electronic social networks and which are trying to be solved are as follows: (1) suppressing the addiction to e-social networking and "online" games on electronic social networks; (2) reducing the number of identity thefts for the participants in e-social networks; and the issue of (3) protecting the electronic information. Addiction to e-social networking among young people exists, while a lot of older people are becoming addicted to electronic social networks. Based on the domestic and foreign research results and their analysis, the paper proves that the addiction to e-social networks exists. The paper presents ways of fighting the addiction to e-social networking. One way of dealing with addiction to the Internet and "online" games on e-social networks, which is described in detail, is setting up parental controls in the operating system (used by addicts) by IT professionals. Today, besides this method of protection from addiction to e-social networks, a number of interesting protection activities, projects and lectures are to be implemented. When it comes to protecting user accounts on e-social networks, users should frequently change their password, and set a strong password. To prevent attempts of an attack on the user through computers, the systems for managing local computer network and the control of electronic information flow are implemented; thus the flow of e-information of social networks users is controlled, which is also described in detail in this paper. In the conclusion, recommendations are made and explanations are given whether to use or not to use e-social networks, considering all the negativity.

Keywords: addiction to e-social networks, attempts of preventing an attack, control of the information flow, e-information protection, internet.

INTRODUCTION

The first part of the paper presents explanations and commentaries of the conducted research results on people addicted to e-social networks, the e-social networks users' abuse, and other threats on e-social networks.

The second part shows the possibilities and ways to protect e-social networks users and to protect electronic information. Nowadays, the Internet and e-social networks are necessary for self-promotion of users, the promotion of products, services, many faculties and their programs, and other organizations.

Figure 1. *Using e-social network for the promotion of University College in the Republic of Croatia*
Source: Facebook. Retrieved on 26th April 2012 from http://www.facebook.com/profile.php?id=1139563573.

Figure 1 presents the promotion of University College RRIF, i.e. a sponsored ad. It is not hard to see why organization for tertiary education use the possibility of such promotions via e-social networking. One of the reasons is the number of users of e-social networks, especially high school students. Today, there is almost no high school student who is not a user of at least one social network. The Internet and e-social networks are an important resource for all users and activities, as well as for their e-learning process. It is necessary to pay great attention to computer security and computer security mechanisms, to the protection of the Internet and e-social networks users, and to the protection of electronic data about all the Internet and e-social networks users. The same way in which young people must be protected, it is necessary to protect elderly people (the Internet and e-social network users), especially teachers who are also exposed to dangers on the Internet and e-social networks. All users need to be guided when using the Internet and e-social networks towards benefits provided by broadband networks. On the Internet, as a new medium, and on e-social networks not everything is negative; there are positive and useful sides of the Internet and e-social networks.

The aim of this paper is to protect the users of e-social networks from threats, addiction, and the possibilities of abuse that they are threatened with on the Internet as the most popular youth medium and e-social networks by making recommendations and methods of protecting electronic information.

Paper Tasks

The paper tasks set on the topic of "Threats and the protection of electronic information on social networks" are as follows: (1) point to possible dangers and threats for the users of e-social networks that exist on the Internet; (2) to show the possibilities of protecting electronic information on e-social networks, to give advice on how to use a particular e-social network, to influence the users of the Internet and e-social networks in order to reduce false presentation on the Internet, and fighting addiction, to describe the combination of characters that comprise an optimum or a strong password. This paper seeks to influence the users of e-social networks by providing rules of conduct that should be respected; to warn the users of the Internet and e-social networks that information once published on the Internet and e-social networks remains on the Internet in most cases forever, (and that they are difficult to "remove" because there are web archives which memorize this information permanently, and that there is a possibility that the information in electronic form and e-documents remain on servers which are no longer parts of the Internet and are owned by the owner of a certain e-

social network); to warn users of e-social networks to be cautious when sending data via chat, which is part of e-social networks, because the other party may present a false name; to make recommendations on the ways of dealing with violations of the rights of the users of the Internet and e-social networks; to alert users to the problem that the addiction to e-social networks and online internet games that are part of e-social networks presents; to display systems for monitoring and controlling the flow of data on the Internet (local networks); to display the privacy settings of certain e-social networks; and to mention how to set parental controls in operating systems to ensure the safety of users.

Research methods used

For the paper entitled "Threats and the Protection of Electronic Information on Social Networks" the following research methods were used: (1) direct observation method; (2) observation method (description of the current state of Internet users is given based on the experiences of the authors); (3) analysis, i.e. the method of content analysis; (4) survey (which extends the already conducted survey with new data collected from the Internet and e-social networks users); and (5) analysis of the results obtained from the survey that was additionally conducted from 20 eApril 2012 to 27 April 2012, in an elementary school (subject teaching) and in high school (in four-year courses).

THE INTERNET AND E-SOCIAL NETWORKS AS A MANIPULATION MEDIUM

The Internet is a global information communication system that connects computer networks of individual countries and organizations, and enables the computer owners, who are also users of the Internet and e-social networks around the world, to communicate with each other, to exchange information and to use many other services through their local and telephone networks (Dragičević, 2004, p. 28). Today, the Internet is a broad term, and there are its many definitions. The Internet is an uncontrolled medium, through which electronic information can be exchanged at high speed. By using the Internet and e-social networks certain information in a digital form is shared faster than via television or radio media. The Internet is a broadband widespread network which connects computers, regardless of their size or group they belong to, and which are connected to the Internet. The Internet can be touched easily if it is observed from the physical level.

The young people's opinion today is focused on playing entertaining games which can be found on the Internet in larger numbers than the educational ones. Older Internet users are also prone to games of chance, online betting and gambling. Based on experience, we can say that the students of vocational schools gamble more. The youth should be guided towards playing educational games, while the elderly users should be directed to use the Internet for useful purposes and gathering of electronic information that can be used for business purposes. Besides entertainment, the Internet is useful for more serious things. It allows finding an address or phone number of the person you wish to contact; buying and selling of personal items; listening to music; watching videos; journey planning; booking and payment of airline tickets; sending and receiving electronic mail using webmail or emails; e-learning; correspondence with other Internet users via web servers and e-social networks that have an IRC service; following the latest news; research; buying and selling securities, and tracking the shares value; distance learning; gathering data on historical figures; translating texts from foreign languages into a language understandable to the user; finding a specific location using

geographic information systems; controlling the consumption of services using the Internet service providers; chatting with and watching a person far away; downloading files; publishing your photos and expressing your opinion via the web site; uploading web pages; CMS and LMS management; downloading free antivirus software. All of the aforementioned features are also the advantages of the Internet. Nowadays, the Internet as a medium can be used to influence public opinion and the opinion of a certain population. In the Republic of Croatia, the Internet as a medium has a very strong influence on the opinion of an average citizen. Numerous organizations as well as individuals now use the Internet and e-social networks as a tool to manipulate the public. It is known that numerous protests are organized through e-social networks, not only in the Republic of Croatia but also in other foreign countries.

Internet structure and the access possibilities

On the Internet, mail servers, web servers, FTP servers, local computers, desktop computers, laptop computers, mobile devices such as tablets and smart phones, and network components such as DSL modems, cable modems, routers and switches can be connected.

Connecting to the Internet is enabled by the ISP (internet service provider). The company, which is the ISP, gives its customers a device for the Internet access, i.e. router, and a username and password that the user can later change. Nowadays, access devices, such as cable modems and ADSL routers, and more rarely modems and ISDN adapters, are used for the Internet access. To access the Internet and e-social networks, three basic types of connection can be used: Dial-Up Connection, Subscribed Connection, and Shared Connection (Engst i Fleishman, 2004).

The Internet connects a growing number of nontraditional end systems such as TV sets, devices in cars, picture frames, household electronic and security systems, web cameras, refrigerators and microwave ovens (Kurose and Ross, 2005, p.2). Nowadays, access to the Internet and e-social networks is not a problem. Besides accessing the Internet from home, we can use it at work, in internet cafés, trams and even taxis.

Newer Internet services

In addition to the basic types of Internet services, such as WWW (World Wide Web), electronic mail, FTP (File Transfer Protocol), Telnet, IRC (Internet Relay Chat), there are tools for e-learning and e-social networks that could largely serve to promote products, services, organizations, faculties, and other educational organizations by using multimedia elements such as text, audio, video, graphics. Nowadays, most Internet users think that the World Wide Web is the Internet, but WWW is only one service on the Internet (global network). www is subdomain usually used to access web sites but it is not service mark. We can say that prefix http in web address represents certain service mark because it signals that we will use HyperText Transfer Protocol which is mostly used for loading of web pages.

PROBLEMS OF E-SOCIAL NETWORKS

E-social networks sometimes cause numerous problems to users and participants. Some users put too much personal information in electronic form in their profile on e-social networks. Malicious people can exploit posted electronic information. Employers can also use this information. Often some e-social network users publish the date when they go on holiday (e.g. I'll be at the seaside next week), which can be used by the burglars in the neighborhood. The problem of e-social networks is hacking Facebook profiles and mail systems and identity theft committed by malicious people. Pedophiles and murderers can also use the e-social networks information.

People addicted to the Internet and e-social networks and the causes of addiction

Everything that causes pleasure during consummation, and suffering because of its lack, we can call addiction. The causes of addiction are often derived from personal and social crisis, the lack of confidence, the need for conformity, boredom, affluence, or idleness (Pezo, 2011). Nowadays, almost all generations almost cannot function normally without the Internet technology. One of the serious dangers of the Internet and e-social networks which threatens all the generations is addiction to the Internet and e-social networks. Addiction to the Internet and e-social networks makes part of contemporary addictions. Addiction is today a major problem for users of e-social networks.

Who can be included in the group of the Internet and e-social networks addicts? All-day users of the Internet or e-social networks (communication with the purpose of solving problems) who are in some ways forced to work using the Internet are not at the same time addicted to the Internet. Addicts to e-social networks like "Facebook" do exist. Time passes by quickly while the addict is searching, viewing profiles, photographs and textual content on the profiles of their acquaintances, friends and famous people from private and public life. There is no end to checking the profiles of "Facebook" users. Each friend has friends whose personal profile contents can be viewed. There is the question: "Can we see a daily or frequent use of the Internet and e-social networks as the Internet addiction"? Today, the Internet is so powerful a medium; without it the business world, economy, banking, education, police, health, and other private and public sectors, including politics and political parties cannot function. People are forced to use the Internet as a medium in certain situations. Those users who due to certain life needs have to work longer hours on the Internet cannot be considered addicts. A group of Internet addicts may include: addicted to electronic mail; the users who are constantly reviewing "Facebook" profiles of other people interesting to them; the users who frequently watch some videos and video clips on "YouTube"; the users of online games which are not educational; the Internet users who frequently view pornography; the addicts to sexual discussions on the Internet; the users of chat services, who would correspond day after day; people who become frustrated if they cannot connect to the Internet for entertainment; the users of "online" gambling, betting and auction bidding; the users of information about other people; the viewers of movies on various online services; the customers who purchase through e-commerce; the participants in online card games; the addicted to downloading songs; the addicted to blogs, forums, etc. The most common causes of addiction to the Internet and e-social networks and online gaming on e-social networks among young people are as follows: (1) poor parental supervision; (2) not responding to viewing inappropriate content by Internet users; (3) passive environment; (4)

online games industry; (5) reluctance of teachers to respond promptly to fight the addiction; (6) not developing critical literacy among students when it comes to the media which manipulate children at schools.

Based on the research of the addiction to the Internet by using the "survey" method, a number of researchers have come to the conclusion that there are people addicted to the Internet and e-social networks based on established criteria.

A research in a neighboring country Slovenia, which was carried out in mid 2002 on the sample of 1194 participants *(N = 1194)* tells of the appearance and the slight increase of the number of addicts to computers and the Internet among young people in high schools. Already at that time, the author came to conclusion that the Internet offers many different options, i.e. services which reduce or make it difficult to control the time spent on the Internet. The author states that the Internet provides an opportunity to ease loneliness, rejection and social pressure (Jeriček, 2011). Studies on the addiction to the Internet and e-social networks have been conducted more frequently in the past fifteen years and even more in some countries. Andre Hanh and Matthias Jerusalem from the Humboldt University of Berlin, conducted a research on the Internet addicts based on a sample of 8,266 participants, of which 7,091 were from the Federal Republic of Germany. The study says that 3.2% of participants formally meet the criteria of the Internet addiction. The group which meets the criterion of addiction spent 34.6 hours a week on the Internet (thus 5 hours a day on average). The next group of Internet users, which is also risky, spends 28.6 hours a week on the Internet (thus 4.09 hours per day on average). Invisible web users use the Internet only 7.6 hours a week (www.onlinesucht.de/internetsucht_preprint.pdf, 2011). Three point two percent (3.2%) of the participants who are addicted (of total) is not much, especially in case of employees who work with Internet technologies within the company. If the aforementioned 3.2% of participants spend 5 hours a day on the Internet after working hours, it may present a significant problem for a person. Such a user necessarily requires abstinence.

Table 1. Addiction of the Internet users to services, in percentages

Internet addiction:				
Addiction to:	**Unnoticeable addiction**	**Potential addiction**	**Addiction**	**Total:**
correspondence	17.8%	26.6%	**35.1%**	79.50%
music	11.7%	14.9%	**14.7%**	41.30%
games, betting	5.4%	7.8%	**11.1%**	24.30%
pornography	6.9%	12.5%	**9.8%**	29.20%
other	21.4%	11.2%	**7.1%**	39.70%
online databases	16.6%	8.5%	**5.2%**	30.30%
online stores	5.6%	4.1%	**3.3%**	13.00%
communication systems	5.7%	4.4%	**3.2%**	13.30%
video-live streaming	2.7%	2.9%	**3%**	8.60%
online auctions	2.4%	2.3%	**2.9%**	7.60%
chat for adults	1.2%	2.6%	**2.8%**	6.60%

Internet addiction:				
Addiction to:	**Unnoticeable addiction**	**Potential addiction**	**Addiction**	**Total:**
Exchange	2.5%	1.8%	**1.7%**	6.00%
gambling with real money	0.1%	0.4%	**0.1%**	0.60%

Based on Table 1 (www.onlinesucht.de/internetsucht_preprint.pdf , 2011) shown by authors André Hahn and Matthias Jerusalem in their paper entitled "Internetsucht: Jugendliche gefangen im Netz", it can be seen that the Internet addiction can be divided into (1) invisible addiction; (2) potential addiction; and (3) addiction. When it comes to 'pure' addiction, on the basis of Table 1 it can be concluded that the Internet users are most addicted to: correspondence enabled by chat service (35.1%); music (14.7%); games and betting (11.1%); and pornography (9.8%). Thirty-four percent (34%) of the total number of surveyed people aged 15-29 years consider themselves addicted to the Internet. Internet users were classified as addicts (as stated in the study) because they spend more than 48 hours per week on the Internet, while being at risk the most are people who spend 10 hours a day on the Internet (Miliša and Tolić, 2011). Spending 10 hours a day on the Internet is too much so it can damage the users' health. Today, on the basis of short informative surveys that are not representative in most cases, it can be concluded that there is a certain number of Internet addicts. According to some estimates, it is stated that in Croatia in 2009 there were about 130,000 addicts to the Internet, aged between 20 and 30. As stated in the review article "The crisis of education and the expansion of modern addictions" („Kriza odgoja i ekspanzija suvremenih ovisnosti"), no one here has systematically dealt with such a problem in a multidisciplinary way (Miliša and Tolić, 2011). This certainly is not good. Practice in western countries is a little different, and experts deal with this kind of problems with the Internet users.

Computer addiction can cause numerous physical, psychological and social problems that need to be taken seriously not only for the young, but also for all generations. Addicted to the Internet and e-social networks often have problems with sleeping at night, disregarding obligations which are placed before them, with learning, and poor grades (the young), with weight, loss of will and motivation for other activities and hobbies. Nowadays, more and more young people learn and write seminar papers by using "copy-paste". Using such a method, young people sometimes do not read the contents and information of each web page on a certain topic, but copy the found content with little understanding, and this kind of work becomes their habit.

In order to protect young people from addiction to the Internet and e-social networks, interesting activities, projects and lectures are being organized. The police publish presentations on the threats of the Internet; articles on children addictions to the Internet are frequently published. Lectures for young people are held in schools on the topic of "Threats on the Internet", in the week with the day of the children safety on the Internet (8 February). Teachers who teach computer science in schools are advised by the heads of their section and representatives of the Education and Teacher Training Agency to organize classes on "Safety of Children and Young People on the Internet" at least one lesson, so that young people would not experience some form of abuse. These lectures are also useful for elderly users of the Internet and e-social networks.

Figure 2[1] presents the division of computer addiction according to the levels. If the computer user is addicted to e-social networks and "online" games, they are also addicted to computer. The bigger problem is the information that 89% of "online" games contain violent content. At the first level, there is the addiction to games on the local computer, Internet addiction and addiction to writing on the computer. During the lessons of computer science, young people often show interest in writing on the computer instead of their notebooks. At the second level, there is addiction to "online games", addiction to e-social networks, web mail addiction, addiction to gambling on the Internet, addiction to blogs, forum addiction, Google search information addiction, cybersex addiction, and Internet shopping addiction. Addiction to e-social networks is divided only in the addiction to the most popular and most frequently used social networks.

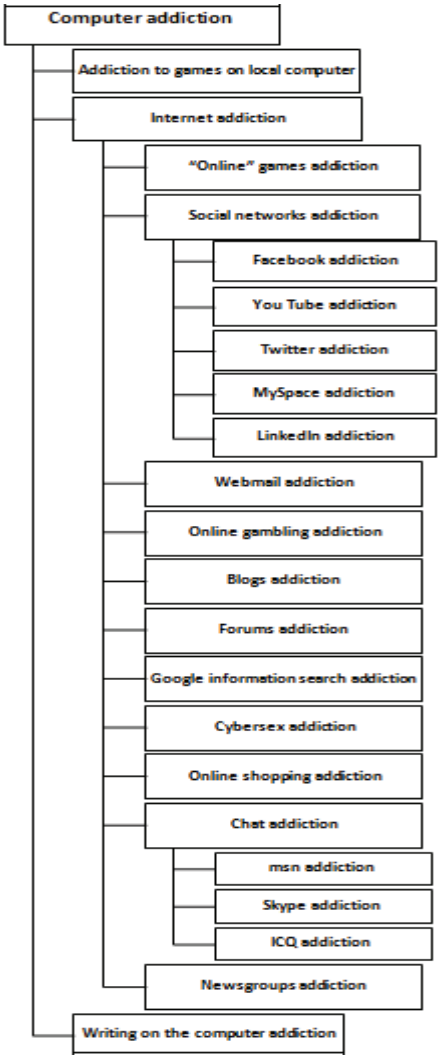


Figure 2. *Division of computer addiction*
Source: Varga, M., Šimović, V., Milković, M. (2012.) Zaštita elektroničkih informacija. Varaždin: VELV. p. 46.

[1] Creating an author. Decomposition addiction on the computer.

From the divisional diagram (Figure 2) (which shows the addictions on the Internet and e-social networks), we can compare the use, popularity and the amount of visiting web sites that contain e-social networks with the popularity and the amount of visiting web sites which contain pornographic content. According to the psychologist Sandra Milotti Ašpan (Milotti Ašpan, 2012) e-social networks have become more popular than web sites with pornographic content. This definition is not strange at all, but it is the evidence that the appropriate services "put an end to" pedophiles and malicious people who download forbidden content and photographs from pornographic web pages (web sites).

Identity theft of the e-social networks users

The cases of identity thefts in e-social networks have been tried to be suppressed by raising charges by the police (Ministry of the Interior) and by sending a special report to the public attorney for young people against malicious people who steal identity of the victim and in the person's name publish their personal information (http://dalje.com/hr-hrvatska/zbog-otvaranja-laznog-profila-na-facebooku-maloljetnik-kazneno-prijavljen/, 2011). Identity theft on e-social networks is also one of the forms of abuse and privacy violation.

Based on the published research by the authors of this paper, which was conducted in April and May of 2012, on the sample of 204 participants *(N = 204)* mostly school children, i.e. in primary and secondary schools in the Međimurje County aged between 13-19, came to the conclusion that the privacy of young people was at risk on the Internet. That was the aim of the research. Additional research was conducted in another two schools in the period from 20 April 2012 to 27 April 2012. The study was conducted in an elementary school (subject teaching) in the Međimurje County and in one high school in Zagreb (four-year programs). In this way, the research sample increased by 86 new participants *(N = 86)*. The total number after the additional research amounts to 290 participants (*N=290*). Young people who were interviewed represent a field sample of the population. This field sample is representative, which means that it has properties which are relevant to the subject of research. Besides the mentioned research objective, clear research tasks were as follows: to obtain information about the opinion of the participants in terms of security of personal information on the Internet and e-social networks; to obtain information on potential threats on the Internet and e-social networks consisting of false presenting of young people in certain schools; to obtain information on the specific number of identity thefts on the Internet and e-social networks from the selected sample; to obtain information on how much the participants publicly vilify on the Internet (since the Internet is a public computer network) and e-social networks; to obtain information on the number of spam received; to obtain information on the frequency of deletion of browsing history; the information on the participants' opinion whether it is good to keep a laptop in a place accessible to everyone. Based on the gathered information, computer science teachers should influence the youth in order to suppress (1) endangering the Internet users, (2) false impersonation on the Internet and e-social networks, (3) vilifying of young people on the Internet and e-social networks by that group of young people where the mentioned abuse is present. In the schools where the research was conducted, efforts will be made to have a positive effect on participants in order to reduce any other form of abuse of both younger and older Internet users. The results were processed and presented in 3D pie charts in MS Excel, a tool for analytical data processing.

Figure 3 shows that 79.3% of participants think that the electronic data placed on the Internet or e-social networks is not safe, while the remaining 20.7% thinks the opposite. Fifty-five point five percent (55.5%) of participants answering the second question agreed that their privacy is mostly compromised on the Internet; 13.1% of participants said they completely agree that their privacy is compromised on the Internet; 24.5% of the total percentage of participants stated that they generally do not agree that their privacy is compromised on the Internet and e-social networks. Privacy of Internet users is not compromised if the user does not allow malicious people to publish their personal and other data to compromise their privacy. Based on the above research, it was concluded that most participants do not make false presenting on e-social networks, which is good and deserves praising. Sixty-three point eight percent (63.8%) of the total number of participants said they had never falsely presented themselves on the Internet and e-social networks, while 36.2% of them falsely presented themselves.

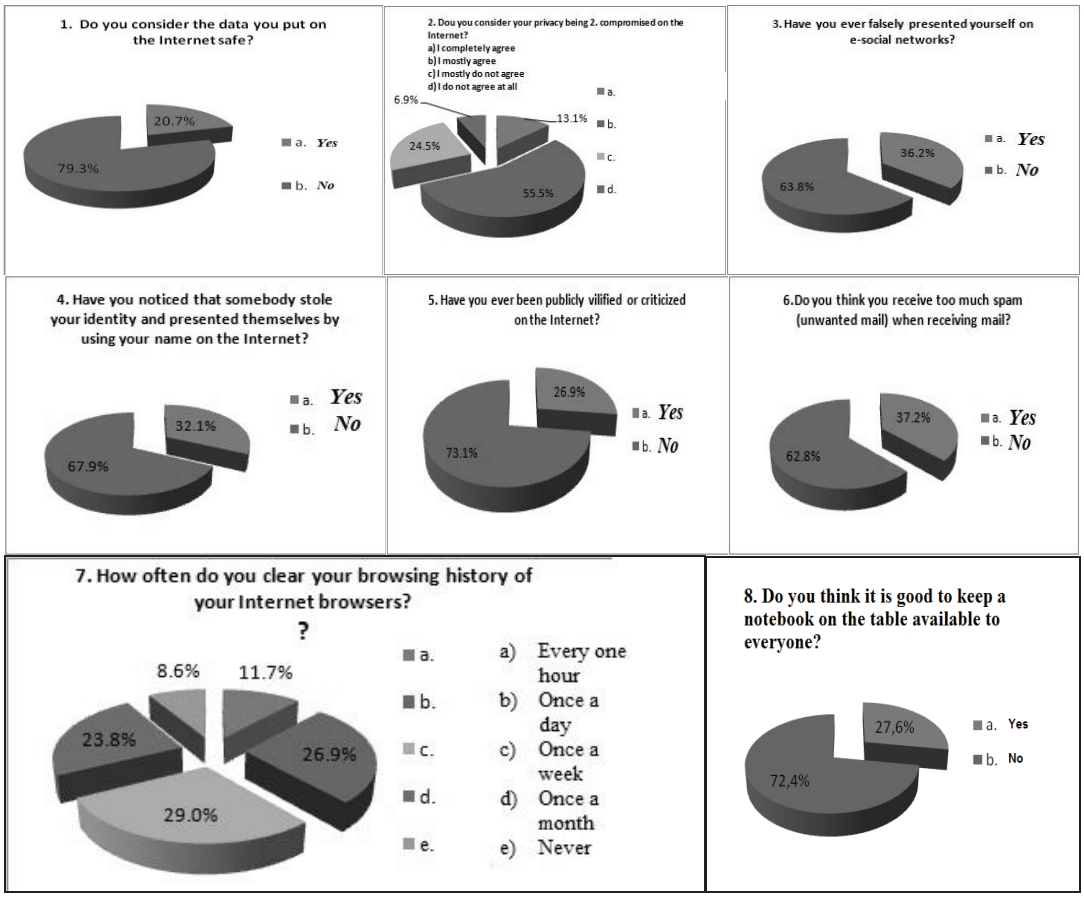


Figure 3. *The results of the survey obtained from the sample of 290 participants*

The situation with young people at schools (where the research was carried out) in terms of identity theft is not alarming (Figure 3). Sixty-seven point nine percent (67.9%) of participants responded that no one stole their identity on the Internet, nor has anyone presented themselves by using the name of the young people interviewed. Thirty-two point one percent (32.1%) of participants had an unpleasant situation when someone else (the attacker) wrote and communicated on the Internet and e-social networks in the name of the participant, at the beginning of communication without their knowledge. Seventy-three point one percent (73.1%) of participants have not experienced public vilification on the Internet,

while 26.9% of participants experienced public vilification and criticism on the Internet and were abused in this way. Sixty-two point eight percent (62.8%) of participants felt that they have not been receiving too much spam in their inbox, while 37.2% of them thought that they did not get too much spam. Cookies are files that your Web browser stores on your hard drive for computer users. Cookies contain information about Internet users and their activities via a web-browser. Cookies are a risk as far as the protection of the system because they can find in it our personal data can get into the wrong hands. If the security system is of great importance, the prohibition of accepting cookies is the best defense.The largest number of participants deletes electronic information on browsing web sites once a week (29.0%), while 26.9% of participants deletes browsing history once a day. Browsing history is deleted once a month by 23.8% of participants, while browsing history is deleted every one hour by 11.7% of participants. Eight point six percent (8.6%) of participants never delete browsing history due to not having the option for remembering the visited web sites enabled in their browser and they do not keep records of browsing history (Pastore, 2004). Most participants think it best not to hold a laptop computer available to everybody (72.4%), while 27.6% thinks otherwise and their personal electronic information is not stored in this way.

Internet and e-social networks users' password safety

Everybody needs to have a user name and password to access a particular service or e-social network on the Internet, i.e. an Internet service provider. It is advisable to change your password every month, and if necessary, it should be changed several times a month. Quite often there are cases when a person finds out the password of another person, and then this malicious person causes them harm in the name of another person. Such a scenario represents one form of abuse of the Internet and e-social networks users. Optimal password used by users of online services should be a minimum of seven characters. It is preferred for a password to contain a combination of uppercase and lowercase letters and numbers. For greater security, sometimes it is necessary to put a character that is used very rarely in the password. It is by no means recommended to use first names, surnames, names of parents, children, date of birth, name of residence, street name, and the like for the password. Such simple passwords are the ones that young people usually use most often. It is not recommended to use for the password the same set of characters. For safety, information systems users should never write down their password on paper and leave it in a drawer to prevent their friends, siblings, or friends to gain access to data and to the user profile on e-social network. The most common attack done by malicious persons on passwords, i.e. the profiles of your friends, is by testing or guessing passwords. Password testing or guessing is an attack in which malicious individuals attempt to access a certain system by randomly guessing the password, where mostly the method of trial and error is used. Although this attack might seem naïve, sometimes it can be effective, especially when malicious person knows the person who set up the password well.

The second most common attack on passwords for Internet users is the so-called “phishing”. The user of a user account receives an unwanted mail written by a malicious person in which it is required to submit the user name and password in the next few days; it says “if you do not send your username and password, you can permanently lose the account”. The recipient of this e-mail has the feeling that the email was sent by the administrator of the web server which provides the service itself. The attacker uses the name of the ISP Internet service provider so that the mail would be more persuasive. Sometimes young people are gullible and

fall for most of these mails. A recommendation to younger and elderly users is to not to fall for such mails, and to not send personal user data in response to such an e-mail.

Privacy settings on e-social networks with regard to Facebook

"Facebook" privacy settings can be adjusted by turning off and deleting. Turning off the "Facebook" profile of young people means that the data and content on the profile would be hidden from the other friends' view, but are stored on "Facebook" servers, in case the user wants to re-activate his or her profile. The user name appears as black text on which you cannot click because the profile is hidden.

By deleting the "Facebook" account, the page is permanently removed. "Facebook" center for help with personal information related to the user account states that permanent deletion deletes information such as a name, e-mail address and mailing address. Copies of some materials (photos, notes, etc.) may remain on the "Facebook" servers due to technical reasons. Permanent storage of photos by "Facebook" is not good for the e-social network users. All the materials on "Facebook" should be detached from any personal identifiers and completely inaccessible to other users. "Facebook" also does not use the contents associated with the accounts which are deactivated or deleted. Before all the data on "Facebook" is deleted completely, several days could go by because there is an option that in the meantime the user could change his or her opinion. When using the e-social network, the "Facebook" user should think twice about the finance policies of the e-social network, and whether they can make profit just by the means of traditional advertising, as well as how the web corporation "Facebook" has achieved such a high value. Facebook profile can be viewed by the executives of the company we work at, business partners we work with, prospect business and love partners, and colleagues, malicious persons, etc. No matter what protection is used on Facebook profile, there is surely someone who could forward our photo to a person who does not quite like us. Our photos can be forwarded by our best friends to their friends who could abuse our digital photograph. Information to be avoided giving on e-social networks are home address and number; photos from the party; admitting not to work and the like; the names of your children; pictures of the apartment and the house; information on the time of vacation; phone numbers because there are applications that display telephone numbers which are posted on Facebook profiles. With all this information, it is not desirable either to count down the days to going on vacation e-social networks.

RECOMMENDATIONS FOR THE PREVENTION OF VIOLATION OF THE INTERNET USERS RIGHTS

In order to prevent violations of the rights of users on the Internet, online services offer the privacy policy and terms of service. Recommendations are to carefully read the rules before using e-social networks and that users adhere to these rules. The user must confirm to abide by the set and stated rules when using online services when creating a profile or user account of electronic web mail. Each Internet service provider tends to set rigorous rules, but the users of Internet services rarely adhere to these rules, and in most cases young people do not read the rules but confirm them automatically by clicking the mouse.

The rule that all users should follow when using the services of correspondence on the Internet is that no activities related to drugs, alcohol and other narcotics should be promoted.

Each individual service provider on the Internet has rules that users must abide by, and these rules should not be mocked at or belittled. It is widely known that the providers of correspondence services do not allow URL addresses of sites and links with content linked to sex or illegal music be published in the writing area. On chat and in newsgroups links of crack sites are not allowed.

Identity theft on e-social networks is among the violations of the Internet users' rights. The way to fight against such violations of users on the Internet is enabling users to authorize themselves biometrically on the Internet services. In this way, it would be easy to identify malicious persons who present themselves by using the names of their colleagues and other users. The only problem with the introduction of biometric authentication system for Internet users is financial viability, and the existence of such a possibility and option for Internet services (the providers of certain Internet services). Nowadays, Internet service providers and the manufacturers of operating systems offer email addresses which the victims of identity theft can complain to and report the case, so as to stop these cases.

THE FORMS OF USERS' VIOLATIONS ON THE INTERNET AND E-SOCIAL NETWORKS

The most common form of user's violation is an abuse. The risks that exist on the Internet, which the users should avoid when "surfing", and which in some way interfere with communication on the Internet and users (especially young people) and can lead to danger are commercial, promotional, offensive, sexual, and value. Commercial risks and dangers that threaten young people include numerous advertising and promotional activities for drugs, alcoholic beverages and tobacco products. The risk for young people may be presented by unwanted mail through which strange and malicious content can be distributed together with sponsored ads. Disclosure of personal information of young people, stalking of young people, illegal downloading of certain content, financial frauds and gambling, are a big problem for Internet users. When young people browse the Internet, there is a risk of experiencing an attack by a malicious person. On the Internet, the users may encounter violence and hatred arousing. Internet users can encounter pornographic content, bullying and other harassment by third parties. There is a possibility that users, especially young people, meet a stranger with strange intentions. Internet and e-social networks users can create and set up inappropriate material and content on a web site (*upload*). The risks of widespread broadband network that Internet users may encounter include misleading electronic information or misinformation and tips; racist statements and aroused hatred for a particular race. On the Internet, with little negligence, users can hurt themselves. A number of cases exist in which a specific web site contains wrong electronic data that young people believe in, i.e. false information or misinformation that makes young people learn in the wrong way, and which makes their development go in the wrong direction. Misinformation is different from information by having no value for the Internet users.

In addition to these forms of the users' violations on the Internet and e-social networks, there are more violations in the form of disturbing and threatening messages, hatred arousing by the service user groups on correspondence services (IRC) directed to a specific person, encouraging further bullying, insulting and spreading violent and abusive comments, creating pages that contain images, drawings, stories and jokes at the expense of peers, sending inappropriate photographs of colleagues, mentioning personal data and information on family

circumstances, spying Internet users via webcam of their computer. Spying young users via webcam of their computer is one of the most serious forms of violation. To make this kind of espionage function, the spy must have access to the computer user who is the target, and must have authorization on the target computer.

An example of this kind of abuse of young Internet users took place in America where school officials were spying their students via webcam. Young people in this case got their computers from the school in order to access the data/resources of that school (http://dnevnik.hr/vijesti/hrvatska/, 2011). In order to fight against this form of violation of young people on the Internet it must be taken into account who the computers are taken and bought from. If young people take or borrow a computer from a person they do not know well or from an organization which sells or services the computer, it would be advisable to pay attention to the possibility of such attacks, and to turn off the camera if they need not to use it.

THE CONTROL OF DATA FLOW ON THE INTERNET IN THE TEACHING PROCESS

In order to protect the Internet users from addiction and other negative sides of the Internet, specific tools that simulate parental supervision should be used, since it is impossible to be 24 hours with the child who browses the Internet. Today there are tools that block access to certain sites on the Internet. Such an option is provided by the tools for managing a classroom or local computer network. Tools to control the data flow can block e-social networks “Facebook” and “YouTube”. SynchronEyes Classroom Management tool is used in teaching by the teachers in schools in the Međimurje County to have supervision and data flow control of computers and computer networks, which students work in. These tools can be used to help students solve the tasks on the computer by taking control of the student’s computer.

The possibilities of certain systems of LAN network management

LAN is a local computer network in a smaller area, organization or institution that is intended for internal use. An example of such a network is the computer network in the classrooms. Teachers Network Management System computers offer many opportunities in the classroom. Systems such as SynchronEyes Classroom Management enable the presentation of content from your computer (screen) to all students in the class, then allow active involvement of students in the teaching by supporting the creation of students groups, and allow the presentation of some solutions on all the computers in class, JIT review of the student’s work, active control of the student’s work using the option of input units control, the creation and implementation of knowledge tests, as well as JIT evaluation of the results, distribution and collection of digital solutions made by students, teaching management in terms of allowing the execution of certain applications and the Internet access, classroom and student computers management, and the management of their works that are currently in digital form.

"Parental" protection of the operating system and OpenDNS

IT professionals can set parental protection on the computer in some operating systems, i.e. parental control over the computer. Since the vast majority of elderly parents especially is not literate enough when it comes to computers to set this type of supervision, for the benefit of users and young users, they should contact an IT professional or an IT company to set up parental control over the account. Through parental controls, the way that the users use the computer can be controlled. IT technician can set limits on the computer owner regarding the hours during which users are allowed to use the computer, the type of game that can or cannot be played, and programs that can be run. When parental control feature blocks access to the game or program, there is a notification that the program is blocked. Users can click a link in the notification to request permission to access a game or a certain program. The access may be allowed by entering the user information. To set up parental controls for the child, you need your own administrator user account. Before the start, it is necessary to check whether the users you want to set up parental control for have a standard user account. Parental control feature can only be applied to standard user accounts. With the control provided by Windows 7 an additional control of a separate provision of services can be installed, such as web filtering and activities reports. In the operating systems, the users' access and opening of specific programs to be used can be limited. OpenDNS allows filtering of web pages which the user wants to access, based on the URL addresses. There are two lists: (1) the list of allowed domains, and (2) the list of banned domains. The top ten contents blocked by OpenDNS include web pages containing pornography in 85% of cases; sexuality in 80.1%; unsavory content in 77.3%; Proxy/Anonimizer in 76.2%; advertising networks in 69%; nudity in 69.2%; discrimination and hatred in 58.7%; lingerie in 58.5%; gambling in 58%; and drugs in 57.3%. E-social networks "Facebook", "MySpace", "YouTube" (www.opendns.com/pdf/opendns-report-2010.pdf, 2010) enter the top three blocked web sites. Based on the research, it can also be concluded that there is addiction to cybersex, social networks, listening to music, chat, etc., because they are not unreasonably blocked and filtered by OpenDNS sites in most cases with the mentioned content. A bad example of blocking certain e-social networks by employers, with the purpose of future employment, is that employers seek from their future employees a username and password of the e-social network they are users of.

CONCLUSION

It is not difficult to conclude that the participants would most often falsely present themselves on those online services and e-social networks they use most. In organizations where the research was conducted (the Međimurje County and a high school in Zagreb) the tendency will be try to have a positive impact on the young Internet e-social networks users with the aim to reduce false presenting on the Internet. With this paper and examples, the existence of violence among users on the Internet and in reality, and (based on the research results) of the Internet and e-social networks addiction in the Republic of Croatia and abroad has been proven, on the basis of a sample of 290 participants *(N=290)*. The next problem that is trying to be solved today is fighting against addiction to the Internet and online gaming on e-social networks. One of the ways to suppress addiction to the Internet that was mentioned in the paper is to place parental monitoring by IT professionals using the options of the operating system and OpenDNS. Moreover, to protect young people from the Internet and e-social networks addiction, interesting activities, projects and lectures tend to be organized. The

publication of presentations on the subject of child protection on the Internet and privacy protection also affect the suppression of the threats on the Internet and e-social networks. Croatian Ministry of Interior[2] also frequently publishes articles on the protection of children on the Internet. In schools, numerous lectures for young people on the topic of "Threats on the Internet" are held. In the week with the day of the children safety on the Internet (February 8), the teachers who teach computer science in schools are advised by the heads of the section and representatives of the Education and Teacher Training Agency to dedicate one lesson on the topic of "Safety of Children and Young People on the Internet", so that young people would not experience some form of abuse mentioned in the paper. When it comes to protecting user accounts on young people e-social networks, young people should frequently change the password, and set the optimal strong password. When it comes to preventing attacks via computers, systems for the management of local computer network (LAN) are often introduced. In this way, the flow of electronic information of young people on the Internet is controlled. Finally, we ask ourselves whether to use e-social networks at all. Our recommendations are to use e-social networks, regardless of any negativity. It is necessary to be cautious with personal information in electronic form and we advise not to believe everything what is said on the Internet or e-social networks. Do not write unverified information about other people. It is necessary to carefully choose which photos from the party you will put on e-social network. It is necessary to take into account possible false presenting of a malicious person, and it is necessary to determine, if possible, which electronic information the social network sells or makes available.

REFERENCES

1. Dragičević, D. (2004), Kompjuterski kriminalitet i informacijski sustavi, Zagreb, IBS.
2. Engst, A., Fleishman, G. (2004), The Wireless Networking Starter Kit, Second Edition, Berkeley, Peachpit Press.
3. Jeriček, H. Internet i ovisnost o internetu u Sloveniji, Medijska istraživanja, 8(2),85-101.
4. Kurose, F., Ross, W. (2005), Umrežavanje računala. Wesley, Računarski fakultet, Sveučilište Masačusets & Bruklin: Politehničko sveučilište, CET, Pearson Addison.
5. Miliša, Z., Tolić, M. Kriza odgoja i ekspanzija suvremenih ovisnosti. Društvo, 4(8), 135-164.
6. Milotti Ašpan, S. Društvene mreže – blagoslov ili prokletstvo, Retrieved on 26th April 2012 from http://www.zdravi-grad-porec.hr/strucne_teme_drustvene_mreze.php.
7. Pastore, M., Dulaney, E. (2004), Security+. Study Guide, Second Edition, Exam SYO-101, IndianaPolis, Wiley Publishing.
8. Pezo, A. Na putu k stvarnoj zaštiti djece na internet, Savjetnica pravobraniteljice za djecu, Retrieved on 31th May 2011 from http://www.slideshare.net/PogledKrozProzor/na-putu-ka-stvarnoj-zatiti djece-na-internetu.
9. Varga, M., Šimović, V., Milković, M. (2011), Zaštita elektroničkih informacija, Varaždin, VELV.
10. Internetsucht: Jugendliche gefangen im Netz. Retrieved on 11th June 2011 from http://www.onlinesucht.de/internetsucht_preprint.pdf.

11. Kaznena prijava (2011), Retrieved on 3th June 2011 from http://dalje.com/hr-hrvatska/zbog-otvaranja-laznog-profila-na-facebooku-maloljetnik-kazneno-prijavljen/362144.
12. OpenDNS 2010 Report. Retrieved on 24th June 2011 from http://www.opendns.com/pdf/opendns-report-2010.pdf.
13. Sponzorirani oglasi. Retrieved on 26th April 2012 from http://www.facebook.com/profile.php?id=1139563573.
14. Špijunaža djece web kamerom (2010), Retrieved on 8th June 2011 from http://dnevnik.hr/vijesti/hrvatska/skola-spijunira-ucenike-web-kamerom.html.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

MEDIATING ROLE OF KNOWLEDGE SHARING ON INFORMATION TECHNOLOGY AND INNOVATION

Onwika Kaewchur, Faculty of Engineering, Kasetsart University, Thailand

Kongkiti Phusavat ,Faculty of Engineering, Kasetsart University, Thailand

ABSTRACT

Purpose: *The purposes of this paper are to examine the relationships among the information technology, knowledge sharing and firm's innovation, and while the knowledge sharing as mediating effect is also simultaneously investigated on the relationship between information technology and firm's innovation.*
Design/methodology/approach: *In this research, the quantitative method was mainly employed. First, the research model was constructed by the literature review process. Then, the hypotheses were launched and tested by the survey method. The questionnaires were used as the tool in collecting data. A total of 224 questionnaires from the herbal manufacturing companies were considered. Multiple regression and Bootstrapping method were employed to test these hypotheses.*
Findings: *The finding showed that the information technology has positively influences on both knowledge sharing and innovation. With regard to knowledge sharing, the findings showed that it has positively influence on innovation, while it also has positively mediated influence on the relationship between information technology and firm's innovation.*
Research limitation/implications: *Data collection of this study was primary focused on herbal manufacturing industry. Collecting data of variety industries would gain more understanding of this relationship. Furthermore, other factors or variables should also investigate in order to understand their effect on innovation.*
Originality/value: *This paper demonstrated that the knowledge sharing and information technology had the critical influence on the organization innovation and played a vital role as a critical success factor of organization.*
Keywords: Knowledge sharing, innovation, information technology

INTRODUCTION

Knowledge is a basis of competitive advantage of firm. Knowledge can be created, recognize, archive, access, and apply by the persons within firm (Nonaka, 1995). This organizational knowledge is usually flowed and distributed within the firm. Moreover, the multiple knowledge is required in order to improve products or services of organization (Lee, 2001).

In particular, the organization knowledge can be created from such past learning, experience, and acquiring new information and knowledge of each individual. Then, sharing knowledge of individual with others will increase the ability to solve problem (Nonaka et al., 2006) and enhance the innovation capability of firm (Lee, 2001; Sáenz et al., 2009). Moreover, the firm cannot survive without explicit or tacit knowledge; both types of knowledge should be integrated and simultaneously performed as Hiroshi Okuda, the chairman of Toyota mentioned that *"The strength of Japanese manufacturing industries are at the technology (based on) tacit knowledge. With the progress in Information Technology (IT), tacit*

knowledge is converted into explicit knowledge. Still, we need tacit knowledge. To build a car, we have to educate people.". In addition, this also indicated the need of IT in the supporting organizational knowledge creation process within firm, as information technology is a supporting factor of organization structure to enhancing organizational performance.

In this research, the herbal industry is focused. It can be said that Thailand is rich in a variety of herbs. As we can see from such increasing the amount of new herbal products has enter to the market, and the trend of herbal consumers has also increased. Moreover, nowadays the herbal industry in Thailand has rapidly growth and is becoming popular. According to the report of Ministry of Industry, Thailand, the amount of herbal manufacturers has continuously increase, which about 23 percent since 2004 to 2012. The creation of innovative products is an important matter of herbal industry. The main focus of the herbal industry is to reduce time-to-market and launch their own unique product. Moreover, the herbal industry has unique characteristics such as a high cost of R&D investment in developing product, and a highly regulatory environment (AmpolMitrivej). Currently, most herbal manufacturers develop the product formulations by themselves and keeps them as a secret, so as to the organization knowledge such knowledge and experience of personnel are the most value to the firm.In addition,almost of herb products in Thailand has been developed by an incremental innovation.

The organization aspect, which may be able to support in increasing innovation performance, is knowledge sharing among individuals within firm. Knowledge sharing can bring a lot of benefits to the firm such as faster speed in creating new innovative products or services. Therefore, the purposes of this research aim to;

- To investigate the relationships among knowledge sharing, information technology, and innovation.
- To identify the mediating effect of knowledge sharing on these relationships.

The next sections of this paper are organized as follows, Section 2 describes the relevant literature review, Section 3 develops the research model and launches the hypotheses for testing, Section 4 presents the research methodology and data collection procedure, Section 5 reports the data analyzing and the results, and Section 6 discusses the results, conclusion, limitation of this study, and further research directions.

LITERATURE REVIEW

Knowledge sharing

In an era of competition, one of the most important intangible assets of organization is the knowledge instead of capital and labor. Nonaka et al. (2006) mentioned that knowledge is a key success factor of organization. The organizations must adopt themselves in order to gain the competitive advantage and survival in a fiercely competitive global economy.
There are much earlier scholar defined the definition of knowledge in many different ways, however, there is no consensus about its characteristics (King, 2009). Two common types of knowledge in knowledge management area consist of explicit and tacit knowledge. First, the explicit knowledge refers to the knowledge that can be easily articulated, expressed in words and numbers, and can be easily stored into repositories, communicated, and reproduced. Second, the tacit knowledge refers to the knowledge that is difficult to articulate, hard to

transfer to others, and based on the experiences and commitments of person. (Nonaka, 1994; Polanyi, 1966)

In the managing knowledge resource becomes an essential issue in developing organization in order to gain and sustain a competitive advantage (Davenport, De Long, & Beers, 1998). Organization knowledge is usually occurred and distributed within organization. Moreover, to improve the products, services, or organizational performance, it requires the multiple knowledge sources. The integration of knowledge can be occurred from the sharing of individual knowledge.

Knowledge sharing is defined as "activities of transferring or disseminating knowledge from one person, group or organization to another" (Lee, 2001, p.324). Moreover, the knowledge sharing can bring the benefits to organization if individuals are willing to share (Nonaka, 1995). One benefit of knowledge sharing has directly effect to organizational performance which is innovation. In another word, knowledge sharing is an ingredient of innovation process. Moreover, it provides other benefits to organization such as increase intellectual capital of organization, interchange between individual competitiveness to organizational competiveness, and reduce organizational cost of employee's gathering knowledge. (Zhang et al., 2005)

Information Technology

During the past decade, much literature in information technology has demonstrated the importance of information technology for improving organization performance. Information technology is a supporting factor of organization factor that increase organizational innovation and performance. Yang and Chen (2007) suggest four main factors of organization level, which has effected on the knowledge sharing. These consist of culture, structure, people, and technology. In technological aspects, they identified that IT infrastructure is the most important factor, and followed by IT know-how, and IT-support. Moreover, Hsu (2006) suggested three approaches that are used to enhance employees' knowledge sharing within organizations: 1) a technology-based approach 2) an incentive-based approach and 3) an organizational-based approach. In a technology-based approach is required such an information technology to support an individual to share their knowledge within organization.

Furthermore, There are two basic approaches to knowledge management forwhich IT can providesupport: codification andpersonalization(Hansen et al., 1999). The codification approach: more explicit and structured knowledge iscodified and stored in knowledge bases. The main role of IT here is to help people to share knowledge through common storage so as to achieve economicreuse of knowledge. e.g. IT tools is electronic knowledge respositories.The personalization approach: more tacit and unstructured knowledge isshared largely through direct personal communication. The main role of IT is to help people locate each other and communicate so as toachieve complex knowledge transfer. e.g. IT tools are knowledge expertdirectories and video conferencing tools.Both are fundamental to understanding the role of information technology in knowledge management.

Innovation

Simple explanation, innovation is the introduction of something new (Davenport, 1993). More explanation such as The Oslo Manual (2005) identified that "innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations".Most innovation definitions are focused on improvement within the organization in order to meet their business goals.

The type of innovation can be categorized into various types. For instance, Tidd et al. (2005) focused on the pathway to examine when creating the innovation. The type of innovation has categorized into four types or can be called 4Ps of innovation. These consist of 1) Product innovation: changes in the things (products/services) which an organization offers; 2) Process innovation: changes in the ways in which they are created and delivered; 3) Position innovation: changes in the context in which the products/services are introduced; 4) Paradigm innovation: changes in the underlying mental models which frame what the organization does. Moreover, the Oslo Manual (2005) categorized innovation into four types which consisted of product innovation, process innovation, market innovation, and organization innovation.

THE RESEARCH MODEL AND HYPOTHESES

The research model was constructed following earlier relevant literature as shown in Figure 1. It shows the research model with all variables. Moreover, it illustrates the relationships among knowledge sharing, information technology, and innovation. Four research hypotheses of this study were generated to test the relationships among knowledge sharing, information technology, and innovation, and the mediating effect of knowledge sharing on the relationship between information technology and firm's innovation.

Moreover, to establish the mediating role of knowledge sharing, four hypotheses were proposed according to Baron and Kenny, 1986, p.1177;

> *"First, the independent variable must affect the mediator in the first equation; second, theindependent variable must be shown to affect the dependent variable in the second equation; and third, the mediator must affect the dependent variable in the third equation. If these conditions all hold in the predicted direction, then the effect of the independent variable on the dependent variable must be less in the third equation than in the second. Perfect mediation holds if the independent variable has no effect when the mediator is controlled."*

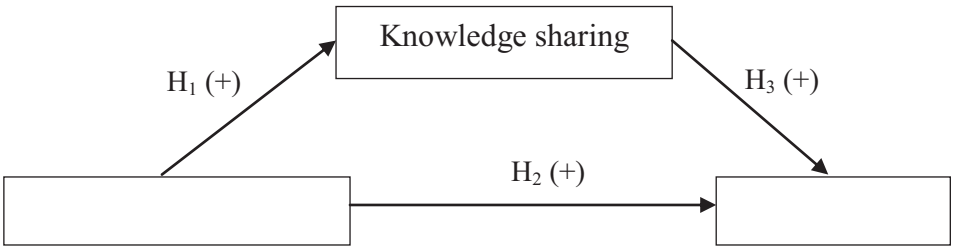


Figure 1 The research framework

Therefore, the hypotheses were established follow the Baron and Kenny (1986) and the earlier relevant literature as follow:

Information technology and knowledge sharing

Information technology is an essential administrative support function, and can increasing the competitive advantagein the firm. Information technologies can not only improving the firm performance, but also supporting knowledge sharing among individuals within firm. For example, Bakhari and M (2010) investigated the influence of technological factors which included information technology infrastructure, know-how, and tools on knowledge sharing quality of government officers in Malaysia. The results showed that information technology know-how such training employees in IT is the most important variables in increasing knowledge sharing quality, followed by infrastructure, and tools. Moreover, much literature argued that IT can support employee's knowledge sharing. Aulawi et al. (2008) described that IT is one of important factor and has directly effect on knowledge sharing behavior of employees. In addition, IT can support the sharing behavior of informal knowledge of employees as well (Davison et al., 2013). Therefore, we proposed the following hypothesis:

H1: Information technology has positively influence on employee's knowledge sharing.

Information technology and innovation

Huang et al. (2009) the level of firm's innovation can be improved by information synergy and IT capability. Bartel et al. (2007) explained that the investment in new information technology in manufacturing firm will valuable thing such increasing the productivity growth, and the product innovation performance. However, the worker skill in IT should simultaneously improve. Therefore, we proposed the following hypothesis:

H2: Information technology has positively influence on firm's innovation.

Knowledge sharing and innovation

Most of earlier literature agreed that the knowledge sharing has influence on innovation. Wang and Wang (2012)pointed out that explicit and tacit knowledge sharing; both have directly influence on firm innovation and performance. Explicit knowledge sharing has more influences on innovation speed while tacit knowledge has more influences on innovation quality. Furthermore, Saenz et al. (2012) focused on the effect of knowledge sharing mechanism on innovation capability. Then, the results indicated that personal-interaction

based knowledge sharing initiatives was the most influential one, and ICT-based knowledge sharing initiatives and knowledge sharing embedded in management processes were respectively significant. Moreover, Liao et al. (2007) argued that knowledge sharing plays an important role in developing firm's innovation. In addition, knowledge must be absorbed and then share between employees with the purpose of increasing firm's innovative capability and benefit to the firm. Thus, we proposed the following hypothesis:

H3: Knowledge sharing has positively influence on firm's innovation.

Lastly, the mediating role of knowledge sharing in the relationship between information and firm's innovation was also test in the last hypothesis. Then, we propose the following hypothesis:

H4: Knowledge sharing is a mediator between information technology and firm's innovation.

RESEARCH METHOD AND DATA COLLECTION

Measurement development

In this study, the measured items of all variables in the research model were primary adopted from the relevant earlier researches. These included three major variables which were information technology, knowledge sharing, and firm's innovation.

Data collection procedure

The quantitative method was employed in this study. The questionnaires were used as the data collection tool. The questionnaires in Thai version were distributed to the herbal industry from November, 2012 to January, 2013. There were totally 224 usable questionnaires.

Reliability Test

The questionnaire design was primarily based on the literature review. The questionnaire were measured the internal consistence reliability based on the Cronbach's alpha coefficient technique. The results indicated that the Cronbach's alpha coefficient of knowledge sharing, information technology and firms' innovation were 0.739, 0.762, and 0.716, respectively, which were above the acceptable level, 0.7. This indicated that each measured items of questionnaire had a high internal consistence.

Measurement

In this study, all of the measured items were adopted from earlier research. These consisted of 3 constructs which were knowledge sharing, information technology, and innovation. Moreover, a five-point Likert scale, which ranged from "1 = strongly disagree" to "5 = strongly agree", was employed to measure all items.

DATA ANALYSIS AND RESULT

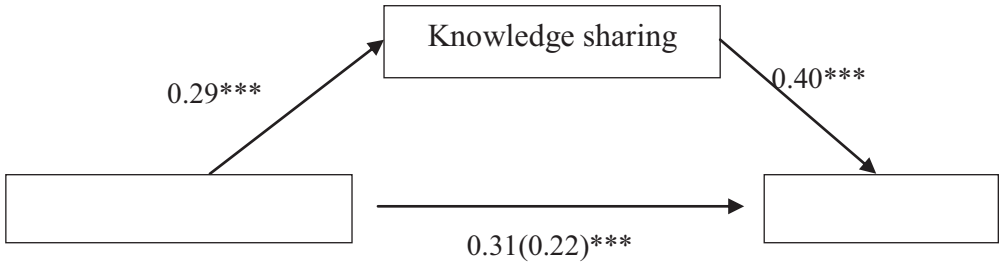
The results of this research found that the relationship between the independent variable, information technology, and the mediating variable, knowledge sharing was positive and significant. Moreover, the relationship between the dependent variable, innovation and the mediating variable, knowledge sharing was positive and significant as well. Therefore, the results of hypotheses testing were following;

H1 presented that the relationship between information technology and knowledge sharing. The results showed that the information technology is positively and significantly (β =0.2984, $t(222)$=6.4397, p<0.001) related to knowledge sharing.

H2 presented that the relationship between information technology and firm's innovation. The results showed that the information technology is positively and significantly (β =0.3135, $t(222)$=9.2709, p<0.001) related to the firm's innovation.

H3 presented that the relationship between knowledge sharing and knowledge firm innovation. The results showed that the information technology is significantly (β =0.4019, $t(222)$=8.9388, p<0.001) related to the firm's innovation.

Moreover, both H_1 and H_2 were significant, mediation analyzes were test by using the bootstrapping method with bias corrected confidence estimates (Preacher and Hayes, 2004). In this study, the 95% confidence interval of the indirect effects was obtained with 5,000 bootstrap resamples (Preacher and Hayes, 2008). The H_4 was tested and the results of mediation analysis confirmed that the mediation role of knowledge sharing in the relationship between information technology and firm's innovation. (β=0.218, CI= 0.0827 to 0.1695). In addition, it indicated that the knowledge sharing provided a partial mediation effect between information technology and firm's innovation. The results of hypotheses testing were shown in Figure 2.



Note: * p< 0.05, ** p< 0.01, *** p< 0.001

Figure 2 Indirect effect of knowledge sharing on the relationship between information technology and firm's innovation

DISCUSSION AND IMPLICATION

This study aims to develop a framework for examining knowledge sharing, information technology, and innovation. The research samples were from herbal manufacturers' employees in Thailand. Moreover, the knowledge sharing, information technology, and innovation were focused on in this study.

The results showed that information technology had positively influenced on knowledge sharing. The results of this study were consistent with the earlier relevant researches (Aulawi et al., 2008; Bakhari and M, 2010; Davison et al., 2013). Besides, the information technology had positively influenced on firm's innovation. The results of this study were consistent with the earlier relevant researches such Huang et al. (2009) and Bartel et al. (2007). In addition, much earlier researches provided a strong relationship between knowledge sharing and firm's innovation such as (Liao et al., 2007); (Saenz et al., 2012); and (Wang and Wang, 2012). The results of this study also indicated that the knowledge sharing had a significant positive influence on firm's innovation. Furthermore, the results indicated that the knowledge sharing was a partial mediator between information technology and firm's innovation. It means that it is not only indirect predict to firm's innovation, it could also supported the information technology influence on firm's innovation.

In case of herbal manufacturing in Thailand, the innovativeness is a key in driven business and competitiveness. Both public and private organizations provided the supporting to herbal manufacturers in order to develop their innovation such as The National Innovation Agency, Thailand. The resulted indicated that most herbal manufacturers focused on their product innovation rather than process innovation. Moreover, most of them had developed their products as the incremental innovation due to some constraints such as high cost in R&D investment and inadequate experts. To develop organization innovation, it requires the multiple source of knowledge. This is not only explicit knowledge, but also tacit knowledge such employee's experience becomes an essential knowledge of organization. The ability of changing tacit knowledge to explicit knowledge and sharing this knowledge with others will be the most valuable to organization. This indicated that the knowledge sharing of employees plays an important role in organization. Moreover, in this study, it indicated that the employees in herbal manufacturer had shared their explicit knowledge rather than tacit knowledge. However, their tacit knowledge could mostly share by training program.

In addition, the information technology becomes an organization factor in increase knowledge sharing and firm innovation. In this study, we found that many herbal manufacturers had emphasized on the information technology issue, however, they focused on the information technology infrastructure rather than the information knowledge of employees. For example, some manufacturers provided the LAN system, and intranet to share their information and knowledge within organization. Moreover, some of them invested in the videoconference system to communicate within organization. Furthermore, some of them preferred to communicate with their employees and customers via social network. However, there are not much organization where had provided training course in information technology to employees. Therefore, organization should provide the effective system of information technology infrastructures, and the knowledge of employees in information technology should be improved such as providing training course to increase knowledge

sharing of employees in the organization and increase the product and process innovation of firm.

LIMITATIONS AND FUTURE RESEARCH

In this research, there are some unavoidable limitations. First, this research was conducted only on a small size of respondents who were the staff level, which might not represent all employees in the firms. Then, to generalize the results for larger groups, the study should have involved more respondents at different levels. Second, this study only focused on the herbal manufacturers, further research could focus on other industry or compare between different industries. Finally, some other relevant variables might be added to the research model and their relationships should be investigated in the future as well.

ACKNOWLEDGEMENT

This research was supported by Ministry of Science and Technology, Thailand.

REFERENT

1. Aulawi, H., Sudirman, I., Suryadi, K., and Govindaraju, R. (2008). Knowledge sharing behavior, antecedent and its influence towards the company's innovation capability. In "IEEE International Conference on Industrial Engineering and Engineering Management, 2008. IEEM 2008", pp. 2092-2096.
2. Bakhari, M., and M, Z. (2010). The Contribution of Technological Factors on Knowledge Sharing Quality among Government Officers in Malaysia. In "Knowledge Management" (P. Virtanen and N. Helander, eds.). InTech.
3. Bartel, A., Ichniowski, C., and Shaw, K. (2007). How does information technology affect productivity? Plant-level comparisons of product innovation, process improvement, and worker skills. The quarterly journal of Economics**122**, 1721-1758.
4. Davenport, T. H. (1993). "Process innovation: reengineering work through information technology," Harvard Business School Press, Boston, Mass.
5. Davison, R. M., Ou, C. X. J., and Martinsons, M. G. (2013). Information technology to support informal knowledge sharing. Information Systems Journal**23**, 89-109.
6. Development, O. f. E. C.-o. a., and Communities, S. O. o. t. E. (2005). "Oslo manual: guidelines for collecting and interpreting innovation data," OECD Publishing.
7. Hansen, M. T., Nohria, N., and Tierney, T. (1999). What's your strategy for managing knowledge? Harvard Business Review**77**, 106-116, 187.
8. Hsu, I.-C. (2006). Enhancing employee tendencies to share knowledge-Case studies of nine companies in Taiwan. Int. J. Inf. Manag.**26**, 326-338.
9. Huang, Y.-H., Li, E. Y., and Chen, J. S. (2009). Information synergy as the catalyst between information technology capability and innovativeness: empirical evidence from the financial service sector.
10. King, W. R. (2009). "Knowledge Management and Organizational Learning," Springer.
11. Lee, J.-N. (2001). The impact of knowledge sharing, organizational capability and partnership quality on IS outsourcing success. Information & Management**38**, 323-335.
12. Liao, S. h., Fei, W. C., and Chen, C. C. (2007). Knowledge sharing, absorptive capacity, and innovation capability: an empirical study of Taiwan's knowledge-intensive industries. Journal of Information Science**33**, 340-359.
13. Nonaka, I. (1995). "The Knowledge-Creating Company," Harvard Business Press.

14. Nonaka, I., Von Krogh, G., and Voelpel, S. (2006). Organizational Knowledge Creation Theory: Evolutionary Paths and Future Advances. Organization Studies**27**, 1179-1208.
15. Preacher, K., and Hayes, A. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. Behavior Research Methods, Instruments, & Computers**36**, 717-731.
16. Preacher, K., and Hayes, A. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior research methods**40**, 879-891.
17. Saenz, J., Aramburu, N., and Blanco, C. (2012). Knowledge sharing and innovation in Spanish and Colombian high-tech firms. Journal of Knowledge Management**16**, 5-5.
18. Sáenz, J., Aramburu, N., and Rivera, O. (2009). Knowledge sharing and innovation performance: A comparison between high-tech and low-tech companies. Journal of Intellectual Capital**10**, 22-36.
19. Tidd, J., Bessant, J. R., and Pavitt, K. (2005). "Managing innovation: integrating technological, market and organizational change," John Wiley and Sons.
20. Wang, Z., and Wang, N. (2012). Knowledge sharing, innovation and firm performance. Expert Systems with Applications**39**, 8899-8908.
21. Yang, C., and Chen, L.-C. (2007). Can organizational knowledge capabilities affect knowledge sharing behavior? Journal of Information Science**33**, 95-109.
22. Zhang, L., Li, J., and Shi, Y. (2005). Study on improving efficiency of knowledge sharing in knowledge-intensive organization. In "Proceedings of the First international conference on Internet and Network Economics", pp. 816-825. Springer-Verlag.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

GRANTS, ENTERPRISE INNOVATIVENESS AND EFFICIENCY

Sabina Žampa, University of Primorska, Slovenia
sabina@riso.si

Štefan Bojnec, University of Primorska, Slovenia
stefan.bojnec@fm-kp.si

ABSTRACT

Purpose: This paper investigates associations between the grants, enterprise efficiency and innovativeness using a combination of enterprise accountancy data and unique in-depth enterprise level survey data. Enterprises in Slovenia can obtain investment and research and development grants from different Slovenian and European Union funds. The focus of the study is on grants for co-financing of purchases of new technological equipment with aim to increase enterprise innovativeness and production of new products.
Methodology: The paper employs unique in-depth survey analysis conducted in the enterprises, which have received grants for innovation activities. The focus of the analysis is on the following four economic-financial indicators: total revenues, number of employees, values of profit and value-added per employee. The principal component analysis and multiple regression analysis are used to test the hypotheses on increase of the value of the four economic-financial indicators and their comparisons.
Findings: During the period 2006-2011, in Slovenia, there were 793 enterprises, which received more than 135.3 million euro of grants. The principal component analysis revealed four principal components: supports for innovativeness, procedures and standards for innovation, innovation as condition and the ways of innovation. The multiple regression analysis confirmed the association between innovativeness as a condition and enterprise efficiency, but not for the other three principal components.
Originality: This is the first research to combine enterprise accounts, grants and survey data in order to quantify the impact of grants from public procurements on the economic-financial indicators and on innovativeness. The originality represents the empirical analysis combining secondary enterprise accounts and public procurement data with unique in-depth survey enterprise level data.

Keywords: grants, enterprise innovativeness, enterprise economic-financial efficiency, Slovenia.
Category: Research paper

INTRODUCTION

In the European Union (EU) countries, European Commission allocates direct financial contributions in the form of grants to projects or organizations that promote European interests or participate in the implementation of EU programs and policies (European Commission 2010). On 18 June 2007, the European Commission confirmed NSRF (National Strategic Reference Framework) to Slovenia as to the thirteenth of 27 EU Member States and it includes priorities, indicative annual allocations, and list of operational programs. The

general orientation of the NSRF is to improve the well-being of the population of Slovenia by promoting economic growth, creating jobs and strengthening human capital and ensuring a balanced and harmonious development, particularly between regions. On one hand, this orientation defines prosperity as a global goal, and on the other hand, it places particular emphasis on promoting economic growth and job creation, which are the key objectives of the Lisbon Strategy, as well as balanced regional development. Small and medium-sized enterprises are eligible for assistance in the form of grants, guarantees and loans.

Economic growth is one of the major objectives economic policies (e.g. Bojnec and Fertő, 2012). The countries that are developing dynamically towards the knowledge society are characterized by (OP KRRP, 2008, 19):

- Intensive investment in research and development (R&D);
- Have developed close connection between public research and education sectors and the economy;
- Experience high degree of innovation;
- Are abounded with highly skilled labour force, and
-

Have developed good information infrastructure with support of good quality of institutions.
The paper aims to investigate associations between the grants co-financing, enterprise efficiency and innovativeness using a combination of enterprise accountancy data and unique in-depth enterprise level survey data. The focus of the empirical research is on grants from public tender P4 for co-financing of purchases of new technological equipment with aim to increase enterprise innovativeness and production of new products. The rest of the paper is structured from the following additional three sections. The second section explains specific grants devoted to supportive environment for entrepreneurship and public tender P4. The third section explains and analyses innovation activities in the enterprises. The fourth section tested the hypotheses on an impact of grants from public tender P4 on the performance and innovation of the enterprises. The final section derives conclusions and implications.

GRANTS

1 Supportive Environment for Entrepreneurship

ERDF (European Regional Development fund) constitutes a financial instrument of the European cohesion policy aimed to strengthen economic and social cohesion and help to redress the main development imbalances in the Community regions.

In the background paper on the promotion of entrepreneurship and competitiveness (updated program of measures to encourage entrepreneurship for the period 2007-2013), a program of measures is based on four basic pillars that are connected to each other in a whole:

1. Promoting entrepreneurship and entrepreneurship-friendly environment;
2. Knowledge for the economy;
3. Development and innovation in the economy;
4. Promotion of small and medium-sized enterprises through equity and debt financing.

The first pillar measures are aimed at promoting entrepreneurship and entrepreneurship education with a view to improve the entrepreneurial culture in Slovenia and to increase awareness and use of support services for potential entrepreneurs and established companies. An important component of measures is development of effective, transparent and supportive environment.

The second pillar measures are devoted to strengthening the internal capacity of companies for more intensive, knowledge-based development, especially in the field of technology in order to enable the Slovenian economy, especially SMEs, to cope with rapid technological progress, which is the main element in increasing competitiveness in the global economy.
The third pillar measures are focused on increased investment in R&D and economic infrastructure of the private and public sectors. Measures to support the development and innovation in the economy are aimed at establishing an effective support environment, the creation of adequate infrastructure at the local and the national level, and strengthening the financial resources for R&D and innovation in the Slovenian economy.

The fourth pillar measures are aimed at financial support to SMEs through equity and debt financing. Venture capital is provided through venture capital funds as a form of equity financing in the context of public-private partnerships.

2. Public tender P4

One of the most interesting public tenders was P4. The subject of the public tender P4 was co-financing (direct subsidies) of the purchase of new technological equipment which represents the initial investment. Initial investments are investments in tangible and intangible assets related to the establishment of a new business, expansion of an existing business, expanding the company's activities into new additional products or a fundamental change in the overall production process of an existing company. The purpose of the public tender P4 is to promote the initial investment, which will be reflected in the greater competitiveness of companies as measured by increased growth and productivity, and more competitiveness on the market and higher value added per employee.

The purpose of the public tender P4 and the criteria for achieving the objectives are oriented in the direction of increasing innovation and value added per employee. This means that through the grants the organizer of the public tender P4 wanted to achieve a higher value of financial indicators, to increase the level of innovation and to increase the value added per employee in companies.

INNOVATION

Innovation is mentioned in all EU strategic documents that are the basis for drawing up public tenders. Receiving grants from the EU is in all public tenders related to innovation. All public tenders which were published for the enterprises and other organisations included reaching objectives by integrating innovation. Organisations were requested to provide: a new product developed by the development team within the organization; a new product developed with external research institutions; a new patent; a new internal innovation; new technological processes; and similar.

1. Innovation as Factor of a Competitive Advantage

The vision of the European Research Area is to connect and bring together different research systems into a single area that will encourage creative thinking, strengthen Europe's competitiveness and enhance the quality of life of its citizens (European Commission 2005, 1). The Lisbon strategy and the Barcelona targets advocate for Europe to become along with Slovenia the world's most innovative economy which should provide sufficient jobs and a high quality of life for citizens (Mulej 2006, 17).

In Slovenia, from 1998 to 2008, a slight growth for a percentage of gross domestic expenditure on R&D of GDP is shown in Table 1. However, Slovenia is still well below the EU average.

Table 1 : Gross domestic expenditure on R&D (% of GDP)

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
EU-27	1.79	1.83	1.85	1.86	1.87	1.86	1.82	1.82	1.85	1.85	1.90
Euro area (EA-16)	:	1.82	1.84	1.85	1.87	1.86	1.84	1.84	1.86	1.87	1.91
Belgium	1.86	1.94	1.97	2.07	1.94	1.88	1.86	1.83	1.86	1.90	1.92
Bulgaria (1)	0.57	0.57	0.52	0.47	0.49	0.50	0.50	0.49	0.48	0.48	0.49
Czech Republic	1.15	1.14	1.21	1.20	1.20	1.25	1.25	1.41	1.55	1.54	1.47
Denmark (2)	2.04	2.18	2.24	2.39	2.51	2.58	2.48	2.46	2.48	2.55	2.72
Germany	2.27	2.40	2.45	2.46	2.49	2.52	2.49	2.49	2.53	2.53	2.63
Estonia	0.57	0.68	0.60	0.70	0.72	0.77	0.85	0.93	1.14	1.11	1.29
Ireland	1.24	1.18	1.12	1.10	1.10	1.17	1.23	1.25	1.25	1.28	1.43
Greece	:	0.60	:	0.58	:	0.57	0.55	0.59	0.58	0.58	:
Spain	0.87	0.86	0.91	0.91	0.99	1.05	1.06	1.12	1.20	1.27	1.35
France (3)	2.14	2.16	2.15	2.20	2.23	2.17	2.15	2.10	2.10	2.04	2.02
Italy	1.05	1.02	1.05	1.09	1.13	1.11	1.10	1.09	1.13	1.18	1.18
Cyprus	0.22	0.23	0.24	0.25	0.30	0.35	0.37	0.40	0.43	0.44	0.46
Latvia	0.40	0.36	0.44	0.41	0.42	0.38	0.42	0.56	0.70	0.59	0.61
Lithuania	0.54	0.50	0.59	0.67	0.66	0.67	0.75	0.75	0.79	0.81	0.80
Luxembourg	:	:	1.65	:	:	1.65	1.63	1.56	1.65	1.58	1.62
Hungary (4)	0.66	0.67	0.79	0.92	1.00	0.93	0.87	0.94	1.00	0.97	1.00
Malta (4)	:	:	:	:	0.26	0.26	0.53	0.57	0.61	0.58	0.54
Netherlands (1)	1.90	1.96	1.82	1.80	1.72	1.76	1.81	1.79	1.78	1.71	1.63
Austria	1.78	1.90	1.94	2.07	2.14	2.26	2.26	2.45	2.47	2.54	2.67
Poland	0.67	0.69	0.64	0.62	0.56	0.54	0.56	0.57	0.56	0.57	0.61
Portugal	0.65	0.71	0.76	0.80	0.76	0.74	0.77	0.81	1.02	1.21	1.51
Romania	0.49	0.40	0.37	0.39	0.38	0.39	0.39	0.41	0.45	0.52	0.58
Slovenia	*1.34*	*1.37*	*1.39*	*1.50*	*1.47*	*1.27*	*1.40*	*1.44*	*1.56*	*1.45*	*1.66*
Slovakia	0.78	0.66	0.65	0.63	0.57	0.57	0.51	0.51	0.49	0.46	0.47
Finland	2.88	3.17	3.35	3.32	3.37	3.44	3.45	3.48	3.48	3.48	3.73
Sweden (5)	:	3.61	:	4.17	:	3.85	3.62	3.60	3.74	3.61	3.75
United Kingdom	1.76	1.82	1.81	1.79	1.79	1.75	1.68	1.73	1.75	1.82	1.88

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Iceland	2.00	2.30	2.67	2.95	2.95	2.82	:	2.77	2.99	2.70	2.65
Norway	:	1.64	:	1.59	1.66	1.71	1.59	1.52	1.52	1.65	1.62
Switzerland	:	:	2.53	:	:	:	2.90	:	:	:	:
Croatia	:	:	:	:	0.96	0.97	1.05	0.87	0.76	0.81	0.90
Turkey	0.37	0.47	0.48	0.54	0.53	0.48	0.52	0.59	0.58	0.72	:
Japan	3.00	3.02	3.04	3.12	3.17	3.20	3.17	3.32	3.40	3.44	:
United States	2.58	2.63	2.69	2.71	2.60	2.60	2.53	2.56	2.59	2.65	2.76

Source: Eurostat 2012

If there are relatively limited R&D expenditures, we cannot, on the other hand, expect to increase innovation and new patents that would place Slovenian enterprises ahead of the competition within the EU and in global trade (Bojnec and Fertő, 2011). In this way, the country is losing competitiveness and more likely deteriorates its international trade competitiveness.

Table 2 presents the Global Competitiveness Index (GCI) for selected European countries in the period 2012-2013. The Slovenian economy is ranked on the 56th place among the world economies, which are included in the comparative analysis of the GCI. .

Rank	Entity	Edition filter		Period	Value	Series
1	Switzerland	2012-2013			5,72	GCI Global Competitiveness I...
3	Finland	2012-2013			5,55	GCI Global Competitiveness I...
4	Sweden	2012-2013			5,53	GCI Global Competitiveness I...
5	Netherlands	2012-2013			5,50	GCI Global Competitiveness I...
6	Germany	2012-2013			5,48	GCI Global Competitiveness I...
7	United States	2012-2013			5,47	GCI Global Competitiveness I...
8	United Kingdom	2012-2013			5,45	GCI Global Competitiveness I...
12	Denmark	2012-2013			5,29	GCI Global Competitiveness I...
14	Canada	2012-2013			5,27	GCI Global Competitiveness I...
15	Norway	2012-2013			5,27	GCI Global Competitiveness I...
16	Austria	2012-2013			5,22	GCI Global Competitiveness I...
17	Belgium	2012-2013			5,21	GCI Global Competitiveness I...
21	France	2012-2013			5,11	GCI Global Competitiveness I...
22	Luxembourg	2012-2013			5,09	GCI Global Competitiveness I...
27	Ireland	2012-2013			4,91	GCI Global Competitiveness I...
30	Iceland	2012-2013			4,74	GCI Global Competitiveness I...
34	Estonia	2012-2013			4,64	GCI Global Competitiveness I...
39	Czech Republic	2012-2013			4,51	GCI Global Competitiveness I...
41	Poland	2012-2013			4,46	GCI Global Competitiveness I...
42	Italy	2012-2013			4,46	GCI Global Competitiveness I...
43	Turkey	2012-2013			4,45	GCI Global Competitiveness I...
45	Lithuania	2012-2013			4,41	GCI Global Competitiveness I...
55	Latvia	2012-2013			4,35	GCI Global Competitiveness I...
56	Slovenia	2012-2013			4,34	GCI Global Competitiveness I...
60	Hungary	2012-2013			4,30	GCI Global Competitiveness I...
62	Bulgaria	2012-2013			4,27	GCI Global Competitiveness I...
71	Slovak Republic	2012-2013			4,14	GCI Global Competitiveness I...
72	Montenegro	2012-2013			4,14	GCI Global Competitiveness I...
73	Ukraine	2012-2013			4,14	GCI Global Competitiveness I...
78	Romania	2012-2013			4,07	GCI Global Competitiveness I...
80	Macedonia, FYR	2012-2013			4,04	GCI Global Competitiveness I...
81	Croatia	2012-2013			4,04	GCI Global Competitiveness I...
88	Bosnia and Herze...	2012-2013			3,93	GCI Global Competitiveness I...
89	Albania	2012-2013			3,91	GCI Global Competitiveness I

Table 2: Global Competitiveness Index for the years 2012-2013

Source: World Economic Forum 2013.

More specifically, Slovenia is among the 144 countries on 56th place as regards the global competitiveness. In the years 2010-2011 it was on 45th place (Schwab 2012, 15), and in 2011-2012 it was on 57th place; this means that in the recent years Slovenia has been losing global competitiveness or global competitive advantage compared to other countries.

2. Economic Environment and Innovation

Slovenia's Development Strategy (UMAR 2005, 8) ranks among the most important national development objectives for 2006-2013 the increased global competitiveness by means of promoting innovation and entrepreneurship.

In Slovenia, in 2008, of all the enterprises, 50.3% were innovative ones, as shown in Table 3. Most innovative enterprises were in Germany, followed by Belgium and Luxembourg.

Table 3: The Share of Innovative Enterprises in Slovenia and in Other EU and Associated Countries

Country	2008
Germany	79.9
Luxembourg	64.7
Belgium	58.1
Portugal	57.8
Ireland	56.5
Estonia	56.4
Austria	56.2
Cyprus	56.1
Czech Republic	56.0
Sweden	53.7
Italy	53.2
Finland	52.2
Denmark	51.9
EU-27 (2)	51.6
Slovenia	*50.3*
France	50.2
Norway	49.2
United Kingdom	45.6
Netherlands	44.9
Croatia	44.2
Spain	43.5
Malta	37.4
Slovakia	36.1
Romania	33.3
Bulgaria	30.8
Lithuania	30.3
Hungary	28.9
Poland	27.9
Latvia	24.3

Source: Eurostat 2012

More than half of the Slovenian enterprises are innovative. The state should provide an economic environment where this innovativeness will represent the competitive advantage of companies.

Bérubé and Mohnen (2009, 222-223) determine the performance for the Canadian enterprises that received grants and tax exemptions. The core activity of analysed enterprises was growing plants. They discovered that the most successful enterprises were the ones which received grants and tax exemptions. The lower is the performance of enterprises that have received only tax exemptions. In addition, the enterprises that have received grants and tax exemptions are much more innovative, have more registered global patents and are more successful in marketing their innovations.

Czarnitzki and Bento Lopes (2011) analyzed the effects of the grants in German enterprises. They showed that enterprises that receive grants – both national and directly from the EU or

both – have a higher degree of innovation than if these resources would not have been received. They found out that the grants which the enterprises received directly from the EU, had a greater effect than national resources. Most likely, the reason behind is that the average size of grants that are drawn directly from the EU is higher. They also concluded that enterprises that have received grants from both sources, they have the highest salaries. As far as patents are concerned, the most successful are the enterprises that have received national resources, or a combination of national and direct EU funding. Most of them make a patent application within the next year t +1.

METHODOLOGY AND DATA

We investigate the relationship between financial indicators and innovation of the enterprises that have received grants from the public tender P4. We measure the financial effects and indirect effects. The financial effects are monitored through financial indicators that are accessible through publicly accessible databases such as Bisnode (2012). Through this group of effects, we examine the impact of the grant from the public tender P4 on the financial indicators of the enterprises: turnover, profit, growth in employment and value added per employee. The indirect effects were monitored through the relationship between financial indicators and innovation of the enterprises and employee satisfaction. This group of effects was measured with data from the questionnaire. The Cronbach's alfa was used to measure reliability of the questionnaire. The principal components method was applied to map each variable into a number of new variables and the principal components. This was followed by multiple regression analysis in which the effects between the dependent and independent variables are determined.

Hypotheses

As part of the research, two hypotheses were tested, namely:

1. H1: Grants from the public tender P4 are positively associated with the performance of the enterprise which is measured by financial indicators.
2. H2: Reaching the effects of grants from the public tender P4 is positively associated with innovation in the company.

Data Collection and Data Processing Data to test the set H1 were obtained through the portal Bisnode (2012). Returned completed written questionnaires were first examined, and then a database was created in Excel and then the set H2 was tested in a computer program SPSS17.

The data collection approach used is a structured written questionnaire. The written questionnaire was anonymous. It included several types of questions: the respondents wrote the answer or they circled the answer among given answers or circled the answer that indicated the intensity of agreement or disagreement with the statement based on Likert scale. The used written questionnaire was accompanied by a cover letter, which explained the aims, objectives and content of research as well as explained the selection approach for the survey's conduction. The written questionnaire was sent to the enterprises on the list of the recipients of the grants from the public tender P4 by e-mail. Data collected by the written questionnaire

from the enterprises are the primary data, which includes nominal, ordinal, interval and ratio variables.

Three different types of information about the respondents are obtained:
- Nominal data give information about naming the categories: enterprise size and statistical region. Based on these data, the structural shares of enterprises are calculated;
- Ordinal data were obtained from answers to questions about innovation and employee satisfaction. Perceptions were measured by using the Likert scale where the respondents' answers had been ranked with a possibility to give the mark from 1 (completely disagree) to 5 (completely agree). Unit of measurement according to the Likert scale is the interval and ratio. Ordinal data were used to measure the variables that determine the innovation and employee satisfaction;
- Interval data are represented by the answers to the questions about the age of enterprise and number of employees.

Written Questionnaire

For the validation of the set H2 a written questionnaire was used. The written questionnaire was prepared in the web application 1ka (Faculty of Social Sciences, 2012). The invitation letter and a link to the written questionnaire were sent by e-mail to the enterprises that have received grants from the public tender P4.

The written questionnaire was divided into five sections:
I. Basic questions about the enterprise, where it was necessary to answer 10 questions, in particular the control variables. In this context, the enterprise gave a written reply and chose a particular value for a particular question.
II. Innovation, which was divided into the following four dimensions: Innovation culture and climate, Innovation and rewards, Creativity as the basis for innovation, and Innovation performance. 22 statements were given on the five-point Likert scale, with possible answers from 1 – very untrue to 5 – very true.
III. Employee satisfaction, which was divided into the following five dimensions: Overall satisfaction, Salary, Organizational culture, Characteristics of work, and Loyalty of employees. 20 statements were given on the five-point Likert scale, with possible answers from 1 – very untrue to 5 – very true.
IV. Reasons for failure to achieve the set goals. 11 statements were given on the five-point Likert scale, with possible answers from 1 – very untrue to 5 – very true.
V. Information about the respondent. The respondent answered the four questions regarding age, gender, education and position in the company ...

Arguments for the second and third set of questions were taken from previous research such as Fatur et al. (2007); Fatur and Likar (2009); Likar and Fatur (2010).

Sample and Units

Data collection through the written questionnaire was conducted by sending an invitation letter and a link to the written questionnaire by e-mail. The enterprises that have received grants are micro, small and medium-sized enterprises. They deal with different economic activities and are from each of the statistical regions in Slovenia. The public tender P4 was

implemented in 2006, 2007, 2008 and 2009. The calculation of financial indicators was made for each of the enterprises that have received grants from the public tender P4. There were 918 successful applications by the enterprises from the year 2006 to the year 2009, of which some enterprises had received several successful applications; therefore there were 793 enterprises that had received grants from the public tender P4 in the period 2006-2009. In 2012, when the financial analysis to test the set H1 started, 55 companies have been exited from the businesses, either being in bankruptcy or insolvent. For 73 enterprises it was not possible to obtain the correct e-mail addresses. Thus, the written questionnaire was successfully sent to 665 enterprises: 118 enterprises answered on the written questionnaire, representing 17.3% of the enterprises that have received the e-mail. They represented 14.9% of the enterprises, which were successful in the public tender P4. The e-mail was sent to the enterprises for the first time on 2nd February 2012. The e-mail to the enterprises that had not responded to the written questionnaire, were re-sent by the e-mail on 28th February 2012. The surveys with the written questionnaire were completed on 11th March 2012.

RESULTS OF HYPOTHESIS TESTING

The Financial Effects: Testing the Set H1

As part of the testing the set H1, a financial analysis of enterprises that have been successful in applying the public tender P4 was conducted. The financial effects were measured by four financial indicators:

- Total revenues,
- Net profit for the period,
- Average number of employees, and
- Value added per employee.

The public tenders P4 were published in the years 2006-2009. For each of the years under consideration, the average increase in the four financial indicators for the enterprises that have been successful in applying to the public tender P4 in the respective year was calculated. In addition, the average increase in the four financial indicators for the enterprises that responded to the written questionnaire was calculated. The number of positive, negative and neutral individual financial effects for the four indicators was calculated. Total revenues, net profit and the value added per employee for the period 2006-2009 were deflated by the consumer price index, which was obtained from SORS (2012).

Table 4: The results testing the set H1, The average increase / decrease, all companies (nominal)

The average increase / decrease over the years in percentages	Year 2006	Year 2007	Year 2008	Year 2009	Average
Total revenues	14,43%	-4,55%	9,47%	12,03%	7,84%
Net profit for the period	21,86%	-111,38%	2,67%	36,61%	-12,56%
Average number of employees	16,06%	6,54%	27,82%	5,27%	13,92%
Value added per employee	7,55%	45,62%	3,11%	1,89%	14,54%

The Principal Component Analysis

The principal component analysis of variables for innovation suggested the following four principal components:

- The principal component 1: Incentives for innovation;
- The principal component 2: Procedures and standards for innovation;
- The principal component 3: Innovation as a prerequisite;
- The principal component 4: Ways to innovate.
-

The criteria for determining the number of principal components were: diagram of Scree plot (where the line breaks), the eigenvalues greater than one and the proportion of explained variance at least 50% and substantive reasonableness.

Testing the Set H2

The purpose of testing the set H2 is to determine the impact of innovation on enterprise's performance. The analysis is based on primary data obtained from the written questionnaire. The set H2 argues that the effects of grants from the public tender P4 is positively associated with innovation in the enterprise, which determines economic efficiency positively. Therefore, in the regression framework, the dependent variable is economic efficiency measured by value added per employee. The independent variables are the four principal components of innovation in enterprises: the incentives for innovation, procedures and standards for innovation, innovation as the prerequisite, and ways to innovate. The tested multiple regression equation is:

$DVZ = a + b_1*INOP + b_2*INOPO + b_3*INOST + b_4*INOSP$ where:

DVZ = value added per employee.

a = regression constant,

b_1, b_2, b_3 and b_4 = regression coefficients,

INOP = Innovation in the way to innovate,

INOPO = Innovation as a prerequisite,

INOST = Innovation as the procedures and standards for innovation, and

INOSP = Innovation as incentives for innovation.

The estimated regression model was shown to be insignificant at 10% level (F = 1.82, Sig. 0.128). The corrected coefficient of determination is 0.028, which means that only 2.8% of the variance in the dependent variable can be explained by the independent variables.

The standardized regression coefficient for the incentives to innovate is -0.056 and is insignificant (Sig. 0.538). The standardized regression coefficient for the procedures and standards for innovation is 0.012 and is insignificant (Sig. 0.897). The standardized regression coefficient for the Innovation as a prerequisite is 0.176 and is insignificant or significant at 6% level (Sig. 0.056). The standardized regression coefficient for the Ways to innovate is 0.163 and is insignificant (Sig. 0.077).

These results would suggest that the innovations increase the value added per employee or that innovation has a positive impact on the value added per employee, which is consistent with the set H2. However, some of these coefficients are insignificant or are on the border of statistical significance at 6-8% of significance level.

The calculated bivariate regression analysis, where is checked whether the principal component Innovation as a prerequisite actually has a positive impact on value added per employee, is tested by the following bivariate regression equation: $DVZ = a + b_1*INOPO$, where:
DVZ = value added per employee,
a = regression constant,
b_1 = regression parameter, and
INOPO = Innovation - innovation as a prerequisite,

The corrected coefficient of determination is 10.9%. The standardized regression coefficient for the Innovation as a prerequisite is 0.347 and is statistically significant (Sig. 0.002).
On the basis of these results can be confirmed that the principal component of innovation as a prerequisite has a positive impact on value added per employee. The other three principal components do not affect the value added per employee significantly.

FINDINGS AND IMPLICATIONS

In the analysis of financial indicators on testing the set H1 confirmed that the enterprises achieved positive financial impacts from grants from the public tender P4. The enterprises that have been successful in the public tender P4 on the basis of the three analysed financial indicators are more successful than the average of enterprises operating in eligible activities. Thus, the set H1 can be validated as confirmed. This imply that the successful companies are more likely to have capacity to efficiently apply and compete in the public tender P4, which is further increasing their competitive abilities and the level of economic efficiency.

To test the set H2, a multiple regression analysis has been conducted using previously estimated principal components as independent variables. In the set H2 is determined the impact of innovation on enterprise's performance. The value added per employee is significantly positively associated with the principal component Innovation as a prerequisite, but not with other three components. This means that the set H2 2 can only be partially validated.

CONCLUSION

The novelty and contribution of the paper is on the assessment of the impact of grants of the public tender P4 to the economic-financial efficiency and enterprise innovation. This research is the first in Slovenia, which measured the impact of a certain tender (i.e., the public tender P4) on the achievement of the aims and objectives identified in the public tender. In addition to the importance for research, it has also important policy implications directed towards the implementation of the public support programs and EU directives in order to measures the overall impact of the grants and to explore the specific aims and the effects achieved.

REFERENCES

1. Bérubé, C. and Mohnen P. (2009), "Are firms that receive R&D subsidies more innovative?", Canadian Journal of Economics, Vol. 42 No.1, pp 206–225.
2. Bojnec, Š. and Fertő, I. (2011), "Impacts of research and development on manufacturing trade", Zbornik radova Ekonomskog fakulteta u Rijeci, Vol. 29 No. 1, pp. 65–88.
3. Bojnec, Š. and Fertő, I. (2012), "Broadband availability and economic growth", Industrial Management & Data Systems, Vol. 112 No. 9, pp. 1292–1306.
4. Czarnitzki, D. and Bento Lopes C. (2011), "Innovation subsidies: Does the funding source matter for innovation intensity and performance?", Empirical Evidence from Germany, No. 11–053, Centre for European economic research (ZEW), Http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1908764 (13 September 2012).
5. European Commission, (2005), Strengthening the foundations of the European research area, 12. Support for the coherent development of policies, Brussels: European Commission.
6. European Commission (2010), Public tenders and financing, Http://ec.europa.eu/contracts_grants/index_sl.htm (11 January 2011).
7. Fatur, P. and Likar B. (2009), Ustvarjalnost zaposlenih za inovativnost podjetja, Koper, Fakulteta za management Koper.
8. Fatur, P., Likar B. and Kopač J. (2007), "Razvoj metodologije za vrednotenje inovacijskih sposobnosti managementa", Revija Les, Vol. 4 No. 59, pp 96-103.
9. Likar, B. and Fatur P. (2010), Inovacijsko tehnološki in raziskovalni procesi v predelovalni in lesni industriji, Koper, Fakulteta za management Koper.
10. Mulej, M. (2006), Poročilo o raziskavi. Maribor, Ekonomsko-poslovna fakulteta.
11. OP KRRP. (2008), Operativni program krepitve regionalnih razvojnih potencialov za obdobje 2007–2013, Ljubljana: Služba Vlade RS za lokalno samoupravo in regionalno politiko.
12. Schwab, K. (2010), The global competitiveness report 2010-2011, Ženeva, Word Economic Forum.
13. Schwab, K. (2012), The global competitiveness report 2012-2013, Ženeva, Word Economic Forum.
14. UMAR, (2005), Strategija razvoja Slovenije, Ljubljana, Urad RS za makroekonomske analize in razvoj.
15. World Economic Forum (2013), The Global Competitiveness Report 2012-2013. Geneva, World Economic Forum. Available at: http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf

LEGAL SOURCES

Dopolnjen Program ukrepov za spodbujanje podjetništva in konkurenčnosti za obdobje 2007–2013. 2007, *Sklep vlade* 31001-1/2007/6.

DATA SOURCES

Bisnode, (2012), *Financial data.* Http://www.bonitete.si/ (14 November 2012).
EUROSTAT, (2012), *Statistical data.* Http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/themes (4 September 2012).
Faculty of social studies, (2012), *Survey questionnaire.* Http://www.1ka.si/ (5 January 2012).
SORS, (2012), *Consumer price index*. Ljubljana: Statistical Office of the Republic of Slovenia. Http://www.stat.si/index.asp (24 March 2012).

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE EFFECT OF CULTURAL AND ECONOMIC CONDITIONINGS ON INNOVATIVENESS IN ECONOMICS

Prof. Agnieszka Sitko-Lutek, Departament of Economics, Maria Curie-Skłodowska University in Lublin, Poland
e-mail: agnieszka.sitko-lutek@poczta.umcs.lublin.pl

M.Sc. Aneta Karasek, Departament of Economics, Maria Curie-Skłodowska University in Lublin, Poland
e-mail: aneta.karasek@poczta.umcs.lublin.pl

The study was financed by Ministry of Science and Higher Education in Poland (National Research Center) Grant NN 115419840.

ABSTRACT

Purpose - *The aim of the study is to identify factors conditioning the innovativeness of countries and regions, those well-developed and less developed ones as well. The analysis will be performed regarding different aspects for European and Asian countries and the United States of America. The analyses will be performed on the basis of the indices and data collected in Global Innovation Index 2012. The work will also present an analysis of the influence of corporate culture on innovativeness, as well as a study of innovativeness in Polish enterprises against the international perspective.*

Design/methodology/approach - *The comparative analysis in the following aspects:*

1. *GDP per capita*
2. *The Global Innovation Index*
3. *Hofstede Culture Index*

The research was focus on the comparison of five countries: Poland, Slovenia, Thailand, Ukraine and USA. The examples was selected not as a random sample but the criteria refer to the variety in values, and innovation dimensions as well as America, Asia and Europe representations based on the triad influences.

Findings - *It is clear that different business environments and culture environment exist throughout triad partners and it influence different innovation approach development.*
There are national culture values strengthening and limiting innovations. Analysing Organizational culture models – in Poland, Slovenia and Ukraine the high power distance and high uncertainty avoidance can be the barriers, in Thailand – long term orientation helps to built life long innovative approach and in USA high individualism and low avoidance of uncertainty helps to generate innovations.
The awareness of organizational culture supporting and limiting values should be used in every day management and international cooperation.

The interrelations of organizational culture and economics phenomenon are of great importance not only for a certain company but also on macro level and it worth to analyze the relations in more details. It shows the need of further research focused on the mutual influences analysis.

The analysis of the collected data indicates that countries with higher score in Global Innovation Index 2012 exhibit a higher level of regional development.

Research limitations/implications - *The research and theory on cross-cultural comparisons is then limited to the acknowledgement that cultural differences exist. The models which have been created to evaluate the transferability or application of theory to a different culture can identify some areas in which problems may be expected but they cannot prescribe methods or techniques to be used in another culture. More intensive research which investigates how culture influence innovation on macro, micro and project level and what leads to effective innovation development in different cultures may lead to working out more useful models. At the moment any cross-cultural application must be made with great care.*

Originality/value *- The authors explain the importance of identification of factors conditioning the innovativeness of countries and regions.*

Keywords: *innovativeness, cross culture comparison, culture dimensions, economic development, national innovation system, economic conditionings*
Classification: *Conceptual/Research paper*

INTRODUCTION

At the time of globalization the existing sources of economic growth, such as relatively low labor costs, availability of cheap resources or favorable geographical situation are insufficient. It is necessary to search for new sources of the competitive advantage, and developmental tendencies in highly developed countries show that the only way to guarantee permanent development is to build up a competitive advantage based on knowledge and innovations. Moreover, it is believed that innovativeness is a multidimensional phenomenon which should not be perceived merely as a linear transition from research activities to launching a new product on the market.

Innovation has been introduced into formal economic growth models in 1957 by Robert Solow, a professor at MIT. He was awarded a Nobel Prize in Economics for this and related work in 1987. Solow defined growth as the increase in GDP per hour of labour per unit time. According to theory, innovation gives a chance to increase a competitiveness and economic growth of country.

The aim of the study is to identify factors conditioning the innovativeness of countries and regions, those well-developed and less developed ones as well. The analysis will be performed regarding different aspects for countries such as Poland, the USA, Thailand, Slovenia and Ukraine. Additionally, an analysis will be carried out to study the effect of the level of innovativeness on the economic development in these countries. The analyses will be performed on the basis of the indices and data collected in Global Innovation Index 2012.

The work will also present an analysis of the influence of corporate culture on innovativeness, as well as a study of innovativeness in Polish enterprises against the international perspective.

NATIONAL INNOVATION SYSTEM

Innovativeness is one of the factors which have an essential effect on the level of economic competitiveness. Innovation capacity has been widely acknowledged as a critical force to national economic growth for developed countries (Nelson 1993, Porter 1990). Competition and innovation are important for the countries in building up the innovation capability as they provide possible pathways to accelerate the process of technological catch-up as well as sustain productivity growth and competitiveness (Porter 1998). Clearly observed differences among particular countries at the level of innovativeness of their economy provided us with an impulse to analyze the agents conditioning their degree. Conditionings concerning the development of innovations are determined by economic, cultural, social and technological factors which are characteristic of individual countries, economies or regions. Although it is commonly argued that countries need to innovate in order to grow and achieve success, it is important to known which factors determinate this. Innovation capacity can be defined on micro (company level) or macro (a national level).

National innovation capacity may only be considered via a properly functioning national innovation system (NIS). The term was coined by C. Freeman and developed in the following years (Lundvall, 1992; Nelson, 1993; Edquist, 1997).

In OECD countries, NIS was standardised and analysis of technology performance and policies has traditionally focused on inputs (such as expenditures on research and development and the number of research personnel) and outputs (such as patents) (OECD, 1997).

The national innovative capacity framework seeks to integrate three perspectives regarding the sources of innovation: ideas-driven growth theory, microeconomics-based models of national competitive advantage and industrial clusters, and research on national innovation systems. While these perspectives contain common elements, each highlights distinct drivers of the innovation process at the national level[1].

An innovation system is a network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect their behavior and performance (World Bank 2006).

National innovative capacity is not the realized level of innovative output per se but reflects more fundamental determinants of the innovation process. Differences in national innovative capacity reflect variation in both economic geography (e.g. the level of spillovers between local firms) as well as cross-country differences in innovation policy (e.g. the level of public suport for basic research or legal protection for intellectual property (IP)).[2]

The actual output of innovation in terms of new goods and services or improved processes is already captured in the gross domestic product (GDP) and the National Income and Product Accounts (NIPAs). The amount and type of investment that lead to innovation, however, are

[1] Stern S., Porter M.E., Furman J.L. (2000), The Determinants of National Innovative Capacity, Working paper 7876, Cambridge, Massachusetts, National Bureau of Economic Research, pp.4.
[2] *Ibid.*, pp. 900.

not captured. This type of information is needed to improve our understanding of economic growth[3].

ORGANIZATIONAL CULTURE CONTEXT OF INNOVATIONS

The era of globalization and the economy based on knowledge creates new challenges for management. Innovation have to be developed faster and more effectively. All the determinants supporting innovative economy and enterprises have to be analyzed and organizational culture is one of the leading ones.

In the literature there are three following levels at which innovation has been researched:

- The macro–focusing on the source of impact of innovation within economies and industries;
- The micro and company – investigating on how companies manage innovation and the advantages that brings them in terms of competitive advantage, revenue and profits;
- The project level looking at the management of innovation projects, particularly new product development.

The organizational culture impact on all three levels is important, although it has not been examined in the macro context very well. The paper tries to fulfill the gap presenting comparison of pro - innovative indicators as well as the organizational culture of selected countries.

One of the key themes underlying the analysis of the issues discussed in this paper is cultural difference in the context of influencing innovation.

There is the view that that the factor, which influence on innovation is organizational culture (Carmeli, 2005). Since it influences employee behaviour, it may lead them to accept innovation as a fundamental value of the organization and to feel more involved in the business (Hartmann, 2006). Consequently, the literature considers organizational culture to be one of the factors that can stimulate the most an innovative behaviour among the members of the organization Furthermore, we suggest that different organizational cultures will be required depending on the innovation models in various countries.

Regarding organizational culture, there is an agreement in the literature about its importance for innovation (Chang & Lee, 2007, Lau & Ngo, 2004, Martins & Terblanche, 2003, Mumford, 2000, Obenchain & Johnson, 2004)

There have been some attempts to separate cultural differences from other environmental differences in research (Saha, 1993; Easterby-Smith et al, 1995) but their overlap in most models for cross-cultural comparisons remains problematic. Hofstede (1996) states that systems and culture are part of the same circle; this would imply that there is no need to separate local environment from culture. However, this assumes that political and economic structures and systems in a country arise from a consensus - then these could be seen to represent an articulate part of national culture.

[3] Rose S., Shipp S., Lal B., Stone A. (2009), Frameworks for Measuring Innovation: Initial Approaches, A. Working Paper #06, Athena Alliance, Science and Technology Policy Institute, pp.1.

As culture represents or expresses values, behaviours and attitudes, it is important to understand cultural differences in order to understand which management methods will work, and how to develop innovation.

There are many manifestations of cultural differences. These are evident in national and regional differences in style, taste, family relations, government structures etc. There is also evidence of differences in working methods and business organisation from one country to another: German co-determination, Japanese management methods etc. The following are a few examples of definitions and methods used to compare cultures.

Hofstede (2010) defines culture as "collective mental programming of human mind which distinguishes one group of people from another. This programming influences the patterns of thinking which are reflected in the meaning people attach the various aspects of life and which become crystallized in the institutions of society" .

Hofstede's method of analysing culture was derived from a survey of work values conducted at IBM between 1968 and 1973. The four dimensions concerned attitudes to authority, group membership, risk and competition versus co-operation. Later work led by Bond at the Chinese University of Hong Kong added a fifth dimension: Confucian dynamism (Bond et al, 1987). The basis of this model is that the dimensions can be measured and compared. The dimensions represent a system of values which are related to behaviour, management practices and methods of organising systems. Schein (1992) disagrees with these methods - he replaces values with 'basic assumptions' which are both taken for granted and non-negotiable (p16). Schein does not agree that cultural assumptions (or values) can be broken down and measured by a survey method.

Culture then is described as something - orientations (Trompenaars, 1993), values (Hofstede, 1980) or assumptions (Schein, 1992) - which is shared by a group of people. There are different groups which can be considered, such as national groups, occupational groups, industry groups and firms. This gives rise to different 'cultures' - that is national business culture, occupational culture and corporate culture. It is clear that people from different cultures do some things differently, for example, they may speak differently and/or treat one another differently. From the models described, it emerges that different approaches to innovation would prevail in different cultures.

Hostede's dimensions are probably the best known and most frequently used but Hofstede himself criticises many of the applications of his questionnaire. The model has a certain elegance - four or five dimensions which can be compared along straight line continuums, some of which have been shown to be related to preferences for different organisational systems as well as to economic development. However, the questionnaire is not designed for 'one-off' measures in a given country.

ORGANIZATIONAL CULTURE INDICATORS

In Hofstede's original research data was collected from a large multinational business corporation (IBM) with subsidiaries in 64 countries. This initial structure consisted of four individual cultural value dimensions.

The first one is *power distance* (PDI). According to Hofstede (1980), power distance is the extent to which the less powerful individuals in a society accept inequity in power and consider it as a normal. In high power distance cultures, individuals respect their superiors and avoid criticizing them, while in low power cultures, it is acceptable to challenge superiors, albeit with respect. The second dimension is *individualism versus collectivism* (IND), reflecting the degree to which a society views its members as individuals or as group members. In individualistic cultures, individuals are mostly concerned with their own interests, while in highly collective countries, they are not defined by their own actions but rather the group' actions. The third dimension is *masculinity versus femininity.* The firs one is described as cultures where the dominant values are expected to ambitious, assertive and competitive, while in feminine cultures there is a dominance of values such as "friendly atmosphere, position security, physical conditions" (Hofstede, 2001, p.281). The last dimension is uncertainty avoidance presenting the degree to which people in a culture generally prefer structure to risk (Hofstede, 1984). Societies high in uncertainty avoidance feel anxious by situations that are unstructured , unclear and unpredictable, while cultures low in this dimension are reflective, less aggressive, relatively tolerant, and unemotional.

The fifth dimension was added by Michael Harris Bond (Chinese Culture Connection, 1987) and was originally labeled *"Confucian dynamism".* It refers to time orientation on life and work and with the long one there is the preference for delayed reward versus the instant one. The most recent Minkov (2007) proposed three new dimensions: Exclusionism versus Universalism, Indulgence versus Restraint, and Monumentalism versus Flexhumanity.

Table. 1. Organizational Culture of countries.

Country	PDI	IND	MAS	UAI	LTO
Poland	68	60	64	93	32
Slovenia	71	27	19	88	-
Thailand	64	20	34	64	56
Ukraine	very high*	low*	low*	very high*	-
USA	40	91	62	46	29

Source: G. Hofstede, G.J Hofstede, M. Minkov, (2010) Cultures and Organizations: Software of mind: Intercultural Cooperation and its Importance for Survival", 3rd ed. London: McGraw-Hill, pp.255-258.
*A.Sitko – Lutek (2004), Kulturowe uwarunkowania doskonalenia menedzerów", PWN, Warszawa.

MEASUREMENT OF INNOVATION

For national innovation system the relationship between innovation inputs and outputs seems crucial. Countries and market agents aspiring to strengthen innovation performance must be efficient in transforming innovation inputs into innovation outputs.

In order to measure national economies' innovation, attempts at standardisation utilising various definitions and data collecting methods have been in progress. Numerous organisations such as OECD, Eurostat, Statistics Canada, Statistics Sweden, INSEAD and

World Intellectual Property Organisation (WIPO) have developed guidelines for the development of innovation indicators.

It is also noteworthy that there exists no perfect set of indicators applying to innovation policies. However, such indicators constitute a useful tool for making international comparisons. The innovation index could also help assess what a country ought to do in order to boost innovation, resulting in fostering economic growth and stimulation of the creation of new workplaces. Furthermore, the innovation index highlights policy challenges – national policies to craft new national innovation strategies. However, conditionings will not replace analyses aiming at establishment of correlations and causal dependencies.

Due to its influence upon economic progress and competitiveness, innovation is a fundamental phenomenon both for developed and developing economies. Innovation is more complex and multidimensional and the level of innovation is not solely influenced by R&D expenditures, which constitute one of the many conditionings.

Innovation is important for driving economic progress and competitiveness – both for developed and developing economies. Many governments are putting innovation at the center of their growth strategies. There exists awareness that the definition of innovation has broadened – it is no longer restricted to R&D laboratories and to published scientific papers. Innovation could be and is more general and horizontal in nature, and includes social innovation and business model innovation as well. It is seen as crucial for inspiring people, especially the next generation of entrepreneurs.[4]

Innovation is important for driving economic progress and competitiveness – both for developed and developing economies. Many governments are putting innovation at the center of their growth strategies. Second, there is awareness that the definition of innovation has broadened – it is no longer restricted to R&D laboratories and to published scientific papers. Innovation could be and is more general and horizontal in nature, and includes social innovation and business model innovation as well. It is seen as crucial for inspiring people, especially the next generation of entrepreneurs.[5]

In order to evaluate and analyse the innovation of national economies, methodology and data collected in "Global Innovation Index 2012. Stronger Innovation Linkages for Global Growth" report will be utilised. The report was compiled by INSEAD and the World Intellectual Property Organisation (WIPO, a specialized agency of the United Nations). In this 5th edition of report, the knowledge partners consisted of the Confederation of Indian Industry, Booz and Company and Alcatel-Lucent. The realisation of Global Innovation Index (GII) was launched by INSEAD in 2007 in order to develop a tool allowing for measurements of nations' innovation. The GII adopts a broad notion of innovation, originally presented in the Oslo Manual developed by the European Communities and the OECD6. GII model includes 141 economies, which represent 94.9% of the world's population and 99.4% of the world's GDP (in current US dollars)7. The advantage of the study lies both in the

[4] The Global Innovation Index 2012, Stronger Innovation Linkages for Global Growth, edited by Dutta S., INSEAD and the World Intellectual Property Organization (WIPO), 2012, pp.4.
[5] *Ibid*., pp.4.
[6] *Ibid*., pp.5.
[7] *Ibid*., pp.6.

number of countries the study encompassed and the amount of statistical data collected and applicable to a more in-depth analysis in the present paper. Moreover, the GII helps to create an environment in which innovation factors are under continual evaluation, and it provides a key tool and a rich database of detailed metrics for refining innovation policies[8].

As regards Global Innovation Index 2012, countries such as Switzerland, Sweden, Singapore and United Kingdom occupy leading positions.

In order to evaluate the influence of economic factors upon the level of innovation, countries of various sizes and level of development were selected. The USA, Poland and Slovenia were selected from among high income economies, Thailand from upper-middle economies and the Ukraine from low-middle economies[9]. Global Innovation Index for the selected countries was presented in Table 2. Individual categories can be scored 0 to 100.

Tabele 2. Global Innovation Index ranking for studied countries.

Country	Rank	Score (0-100)
United States of America	10	57,7
Slovenia	26	49,9
Poland	44	40,4
Thailand	57	36,9
Ukraine	63	36,1

Source: authors' own study based on data from the Global Innovation Index 2012.

The Global Innovation Index (GII) relies on two sub-indices, the Innovation Input Sub-Index and the Innovation Output Sub-Index, each built around pillars. Each pillar is divided into three sub-pillars and each sub-pillar is composed of individual indicators, for a total of 84 indicators[10]. The data used in a raport are from 35% from 2010, 21% from 2009.[11]

ANALYSIS OF ECONOMIC CONDITIONINGS INFLUENCING INNOVATION OF THE STUDIED COUNTRIES (BASED ON GLOBAL INNOVATION INDEX 2012)

For the purpose of Global Innovation Index 2012 evaluation the research team selected individual conditionings which, based on the team's experiences, influence the level of innovation[12].

[8] *Ibid.*, pp.4.
[9] Categorisation as regards the value of income was conducted by World Bank Income Group Classification (April 2012).
[10] More in: The Global Innovation Index 2012, Stronger Innovation Linkages for Global Growth, edited by Dutta S., INSEAD and the World Intellectual Property Organization (WIPO), 2012.
[11] *Ibid.*, pp.5.
[12] Based on: The Global Innovation Index 2012, Stronger Innovation Linkages for Global Growth, edited by Dutta S., INSEAD and the World Intellectual Property Organization (WIPO), 2012.

The GII helps to create an environment in which innovation factors are under continual evaluation, and it provides a key tool and a rich database of detailed metrics for refining innovation policies.[13]

Global Innovation Index 2012 conditionings influencing the level of innovation were divided into 7 pillars. The analysis of their influence upon the selected countries' innovation was carried out.

Global Innovation Index 2012 report specifies the following pillars:

Institutions

Institutional framework, which encourages and facilitates development of innovative activities for businesses and R&D institutions, is fundamental for innovative development of a country. Moreover, good governance and the correct levels of protection and incentives are essential for innovation. The Institutions pillar captures the institutional framework of a country.

This pillar includes 3 sub-pillars[14]:

- political environment,
- regulatory environment,
- business environment.

Among the analysed countries, institutions pillar had the greatest influence upon the level of innovation in United States of America and Slovenia. In case of the Ukraine, the factor exerted an unfavourable influence on the level of innovation. Figure 1 presents scores for individual countries.

[13] *Ibid*., pp.5.

[14] *Ibid*., pp.44.

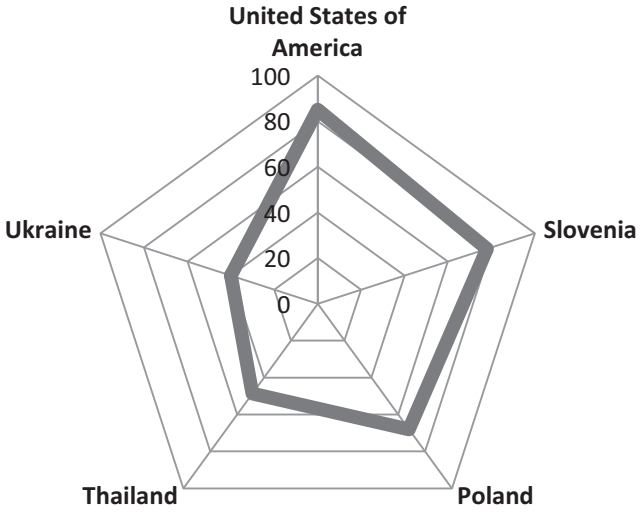


Figure 1. Scores for individual countries as regards Institutions pillar.
Source: authors' own study based on data from the Global Innovation Index 2012.

Political environment, including political stability and government effectiveness, is of strategic importance as regards the development of innovation. Data indicate that for low-income countries such as Thailand and the Ukraine, the factor exerts unfavourable influence upon the level of innovation.

Business environment also belongs to factors influencing the level of innovation. It defines the ease of starting and resolving a business and also the ease of paying taxes. In case of the Ukraine, this particular factor hinders the development of innovation, which seems to have found confirmation in results of the study. The country ranked 137th among 141 evaluated countries. As a consequence of troublesome tax-paying procedures, Poland also ranked among the low-scoring countries (95th out of 141 countries).

Human capital and research.

Education system in the country, tertiary education and well-developed research and development area constitute an important factor influencing the innovation capacity of a nation. In GII 2012 report, the following sub-pillars encompass the pillar[15]:

- education,
- tertiary education,
- research& development.

This factor influences the level of innovation in USA and Slovenia the most, which was presented in Figure 2.

[15] *Ibid*., pp.44.

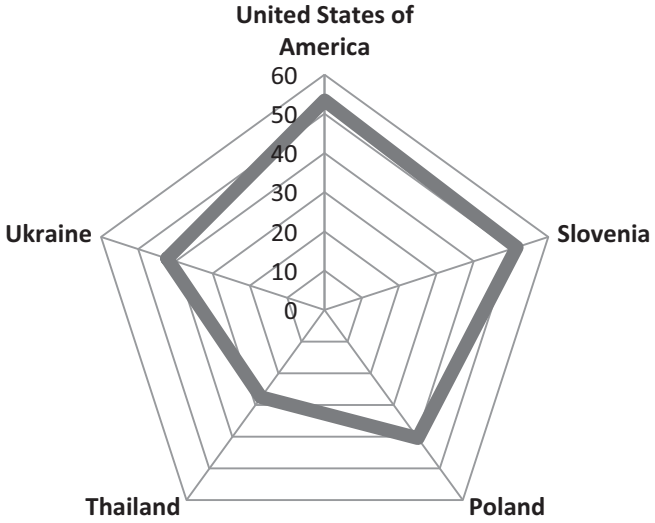


Figure 2. Human capital and research pillar- ranking for the individual countries.
Source: authors' own study based on data from the Global Innovation Index 2012.

Education system was evaluated the highest for Slovenia (ranked 14th), Poland (30th) and USA (31st). Thailand ranked the lowest (97th position) among the evaluated countries. Tertiary eduction, on the other hand, influences the innovation of the Ukraine the most. In case of Thailand it constitutes the factor exerting an unfavourable influence upon the country's innovation.

Research and Development is an economic factor conditioning the innovation of a country. As regards the factor, USA ranked the highest (12th position) and Thailand the lowest (84th position). Gross expenditures on R&D (%GDP) considerably influenced these scores with USA ranking 9th and Thailand 82nd.

Infrastructure.

The development of infrastructure, good and environmentally friendly transport and energy infrastructure facilities present opportunities for the search of innovation and its sources which may serve increased productivity and efficiency, lower transaction costs, better access to markets, and sustainable growth. This pillar includes 3 sub-pillars[16]:

- ICT,
- general infrastructure,
- ecological sustainability.

Figure 3 presents scores for individual countries as regards the development of infrastructure. Infrastructure, in particular information&communication technologies which support innovative processes, exerts positive influence on the level of innovation in USA. In case of the Ukraine, the factor has unfavourable influence upon the level of innovation, in particular

[16] *Ibid,* pp..44.

ecological sustainability (110th position in the ranking) and general infrastructure (98th position).

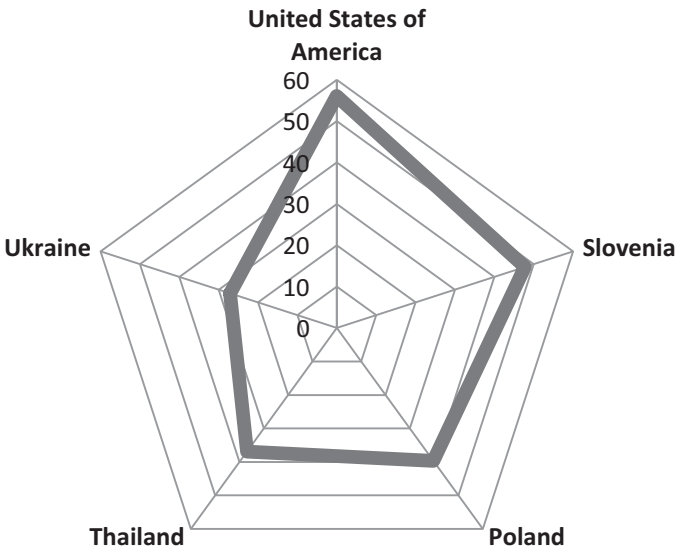


Figure 3. Ranking for the individual countries as regards Infrastructure pillar.
Source: authors' own study based on data from the Global Innovation Index 2012.

Market sophistication.

During the economic slowdown the factor gained importance for the development of innovation. The availability of credit, investment funds, and access to international markets are crucial for entities who desire to develop their innovation. This pillar includes 3 sub-pillars[17]:

- credit,
- investment,
- trade&competition .

The factor significantly influenced the level of innovation in USA which ranked 2nd in the ranking. USA boast ease of obtaining credits and high total value of stock traded. As regards the Ukraine, the factor exerted unfavourable influence (68th position) especially concerning protection of investors and intensity of local competition. Figure 4 presents values of the factor for individual countries.

[17] *Ibid*., pp.44.

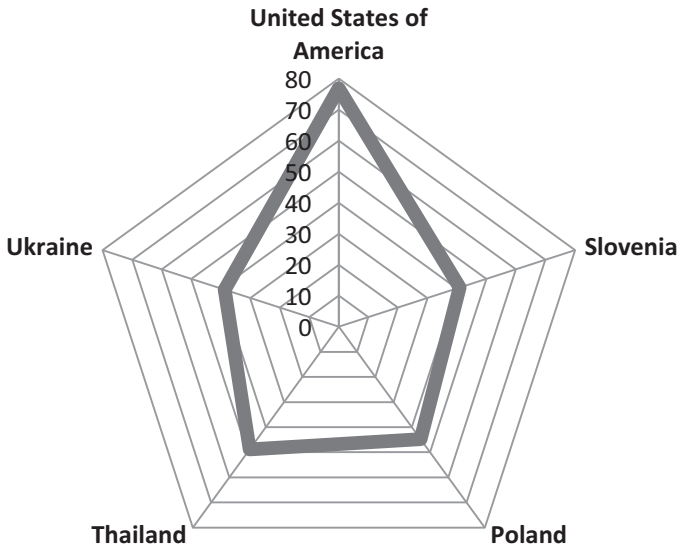


Figure 4. Scores for individual countries as regards Market sophistication pillar.
Source: authors' own study based on data from the Global Innovation Index 2012.

Business sophistication.

This factor defines the level of business sophistication to assess how conducive firms are to innovation activity, and includes 3 sub-pillars[18]:

- knowledge workers,
- innovation linkages,
- knowledge absorption.

Business sophistication exerted the most considerable influence upon the level of innovation in USA (9th position in the ranking), especially as regards knowledge workers in USA. Innovation linkages, collaboration among universities and industry in particular, have positive influence upon the level.

In Poland, this factor had unfavourable influence upon the level of innovation. This is a consequence of a low number of innovation linkages. Thailand stands out from among the evaluated countries with its score in knowledge absorption which is the highest among the countries. Figure 5 presents detailed information pertaining to scoring in this area.

[18] *Ibid*., pp.44.

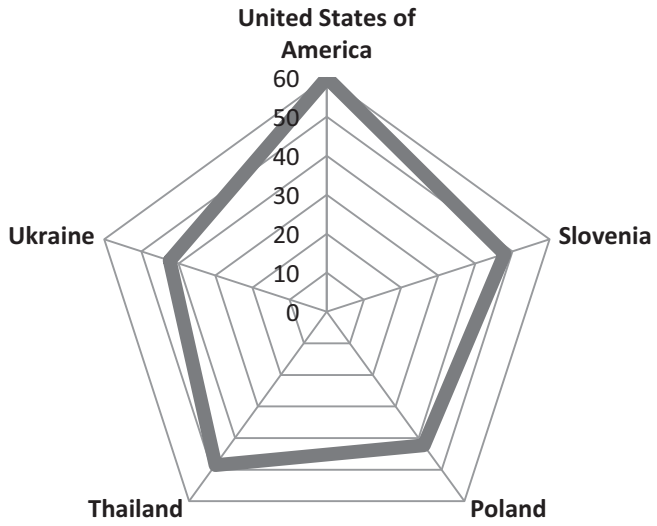


Figure 5. Scores for individual countries concerning Business sophistication pillar.
Source: authors' own study based on data from the Global Innovation Index 2012.

Knowledge&technology outputs.

In a knowledge-based economy, where knowledge is the basis for competitiveness, numerous countries rely upon knowledge to gain a competitive edge. Innovation capacity has become a key factor in shaping economic processes, individual, economic and social development. This conditioning covers all variables traditionally considered as fruits of inventions and/or innovations. This pillar includes 3 sub-pillars[19]:

a. knowledge creation,
b. knowledge impact,
c. knowledge diffusion.

As regards the pillar, USA, which occupies 11th position in the ranking, was evaluated the highest. Poland (51st position) and Thailand (50th position) were evaluated the lowest. Evaluations are presented in Figure 6.

[19] *Ibid*., pp.44.

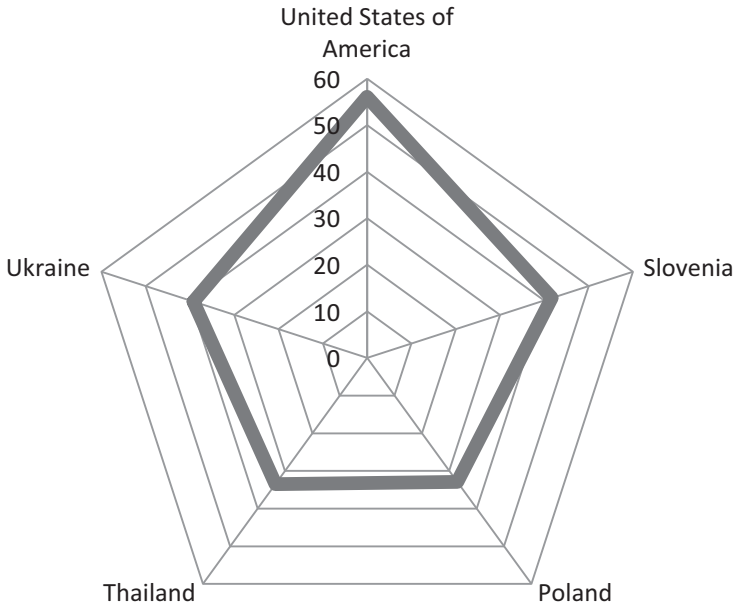


Figure 6. Scores for individual countries concerning Knowledge&technology outputs pillar.

Source: authors' own study based on data from the Global Innovation Index 2012.

The factor exerts considerable influence upon the Ukraine's innovation. Results obtained in knowledge creation contribute to this fact in particular (21st position in the ranking). The first position in the ranking deserves closer attention as regards domestic res utility model ap/BN PPP$ GDP.

Creative outputs.

The influence of creativity upon the level of innovation is undervalued. However, in recent years and in connection with the economic slowdown, it has proven to be fundamental for economic development. According to D. Hübner, creativity may be perceived as the main source of innovation i.e. translating creative ideas into products and services. In this respect, creativity is present where innovations lead to economic results[20].

The GII has always put emphasis on measuring creativity as part of its Innovation Outputs pillars. This pillar includes 3 sub-pillars[21]:

- creative intangibles,
- creative goods & services,
- online creativity.

The factor influenced the level of innovation is Slovenia the most. On the other hand, Thailand was influenced unfavourably, which is reflected in Figure 7.

[20] Creativity and innovation, Driving competencies in the Regions, Panorama inforegio, European Union, Regional Policy 2009, Spring 2009, pp.29.
[21] The Global Innovation Index, op.cit., pp.44.

It is noteworthy that in case of Slovenia, Madrid resident trademark reg/bn PPP$ GDP is the best among all 141 evaluated countries.

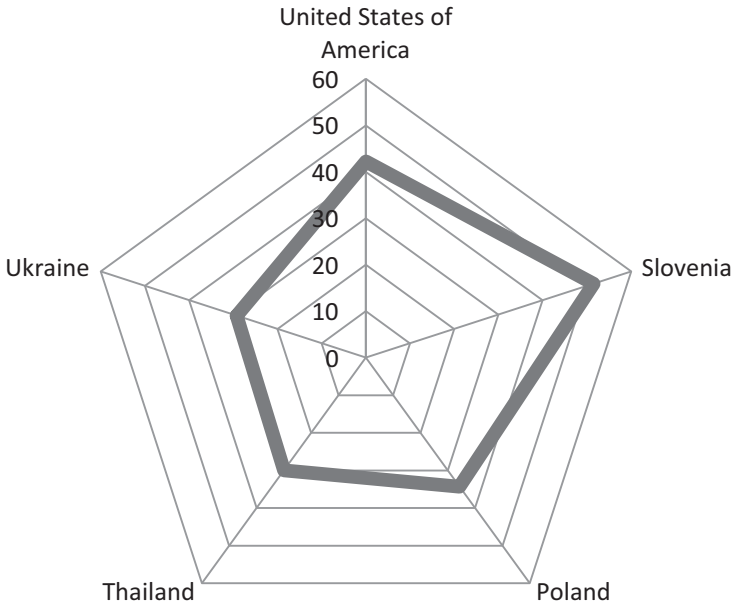


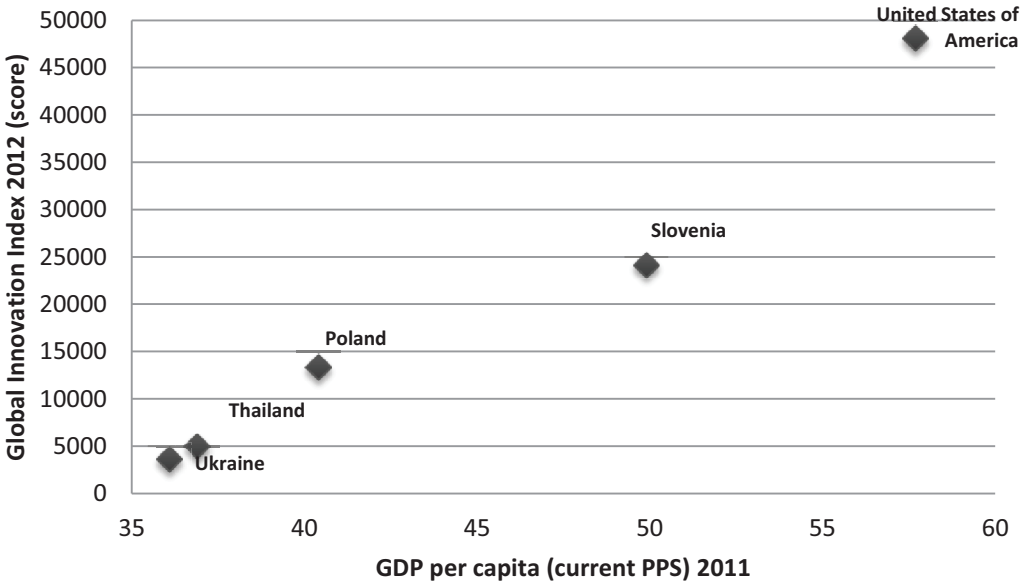
Figure 7. Scores for individual countries as regards Creative outputs pillar.
Source: authors' own study based on data from the Global Innovation Index 2012.

The analysis of level of innovation's influence upon economic development

For years, the increase of economic growth has been measured in Gross Domestic Product per capita (GDP per capita). This is one of the most frequently used benchmarks for measuring economic growth. The increase in GDP does not necessarily translate into the improvement of material situation of the society because GDP may not be streamed into the increase of consumption but rather to boosting production investments e.g. purchase of new technologies, establishment of new businesses, etc. GDP does not constitute the best yardstick when analysing standards of living as it does not reflect qualitative changes. Moreover, it does not provide full information on living standards and wealth.

In order to conduct international comparisons GDP per capita (GDP per capita= GDP/ population of a country) was expressed in USD.

For the selected countries, the analysis of the level of innovation's influence (expressed by Global Innovation Index 2012) upon the economic growth (expressed in GDP per capita) was carried out. The relationship was presented in Figure 8. The analysis indicates the existence of a relationship between the two, which seems to corroborate the hypothesis presented in the paper.



Graph 2. Ranking position vs. GDP per capital
Source: authors' own study based on data from the Global Innovation Index 2012.

The analysis of level of innovation's influence upon economic development was carried out for the selected countries. The level of innovation for individual countries was taken from Global Innovation Index 2012. The level of economic development is presented by means of GDP per capita (current PPS) 2011. Data was taken from World Bank Income Group Classification (April 2012).

The analysis of the collected data indicates that countries with higher score in Global Innovation Index 2012 exhibit a higher level of regional development, which seems to justify the thesis put forward in the paper.

SUMMARY

One ought to remember that when discussing innovate on of an economy, the general state of technical development of a country is a function of three main actors (science, industry, government). The level of innovation depends largely on their involvement and results of their activities.

Summing up there are three culture model – the European one containing Poland, Slovenia and Ukraine, Asian – Thailand and American – USA. They are closely connected with innovation preferences and building the competitive advantage. Cultural values limit the innovative approach in the European model through two dimensions: high power distance and resistance to change expressed by high uncertainty avoidance.

There are also internal differences between researches counties- Slovenia very much in favor is based on collective approach, which helps to stimulate proactive projects.
Asian model represented by Thailand supports innovation in terms of long term orientation and patient, system even life- time approach to innovation.. It allows to receive systemic results.

The basic support for innovation in American model seems to be high individualism and low uncertainty avoidance. It stimulates activity of employees and openness to change.

Cultural values review shows that organizational culture of every country influence the specific innovation model applied in particular region. It is very important to identify it in order to focus on the supporting ones and reducing the barriers.

In order to boost the economic development, increasing the level of innovation seems crucial. The increase in only possible when conditionings exerting influence on it are clearly defined. The analysis indicates that the level of innovation is influenced both by economic and social conditionings presented in the paper. The analysis indicated that countries with higher scores in Global Innovation Index 2012 exhibit a higher level of economic development.

It is noteworthy that innovation rankings constitute a yardstick and a benchmarking tool for innovation performance across countries. These tools enable observation of activities undertaken by individual countries, adoption of worked-out solutions and introduction of changes in innovation policies.

REFERENCES

1. Bond et al (the Chinese Cultural Connection) (1987), Chinese Values and the Search for Culture-Free Dimensions of Culture, Journal of Cross-Cultural Psychology, Vol 18, part 2 (June), 143-164.
2. Carmeli, A. (2005), "The relationship between organizational culture and withdrawal intentions and behavior". International Journal of Manpower, vol. 26, no. 2, pp. 177-195.
3. Chang, S. C. and M. S. Lee (2007), "The effects of organizational culture and knowledge management mechanisms on organizational innovation: An empirical study in Taiwan". The Business Review, vol. 7, no. 1, pp. 295 – 301.
4. Creativity and innovation, Driving competencies in thRegions, Panorama inforegio, European Union, Regional Policy 2009, Spring 2009. http://ec.europa.eu/regional_policy/sources/docgener/panorama/pdf/mag29/mag29_en.pdf
5. Easterby-Smith M., Malina, Yuan (1995), How culture-sensitive is HRM? A comparative analysis of practice in Chinese and UK companies, International Journal of Human Resourse Management, 6/1, 31-59.
6. Edquist, C. (ed.) (1997), Systems of Innovation: Technologies, Institutions and Organizations, London: Pinter/Cassell.
7. Freeman, C. (1987), Technology policy and economic performance: lessons from Japan. London: Pinter.
8. Hartmann, A. (2006), "The role of organizational culture in motivating innovative behaviour in construction firms". Construction Innovation, vol. 6, no. 3, pp. 159- 172.
9. Hofstede, G.(1980), Culture's Consequences: International Differences in Work-Related Values, Sage.
10. Hofstede, G. (1996), An American in Paris, Organization Studies, 17/3.
11. Hofstede, G., Hofstede G.J, Minkov M.(2010), Cultures and Organizations: Software of mind: Intercultural Cooperation and its Importance for Survival", 3rd ed. London: McGraw-Hill.

12. Lau, C. M. and H. Y. Ngo (2004), "The HR system, organizational culture, and product innovation". International Business Review, vol. 13, no. 6, pp. 685-703.
13. Lundvall, B-Å. (1992) (ed.). National Systems of Innovation: Towards a Theory of Innovation and Interactive learning, London: Pinter.
14. Martins, E. and F. Terblanche (2003), "Building organizational culture that stimulates creativity and Innovation". European Journal of Innovation Management, vol. 6,no. 1, pp. 64-74.
15. Mumford, M. D. (2000), "Managing creative people: Strategies and tactics for innovation". Human Resource Management Review, vol. 10, no. 3, pp. 313-351.
16. National Innovation System (1997), OECD.
17. Nelson, R. (1993), National Innovations Systems: A Comparative Analysis, University of Illinois at Urbana- Campaign's Academy for Enterpreneurial Leadership Historical Research Reference In Enterpreneurship.
18. Obenchain, A. and W. Johnson (2004), "Product and process innovation in service organizations: The influence of org". Journal of Applied Management and Entrepreneurship, vol. 9, no. 3, pp. 91-113.
19. Porter, M. E. (1990), The Competitive Advantage of Nations. New York (NY): Free Press.
20. Porter, M. E. (1998), "Clusters and Competition: New Agendas for Companies, Governments, and Institutions," On Competition.Boston (MA): Harvard Business School Press.
21. Rose, S., Shipp S., Lal B., Stone A. (2009), Frameworks for Measuring Innovation: Initial Approaches, A. Working Paper #06, Athena Alliance, Science and Technology Policy Institute, pp.1.
22. Saha (1993) Managing HR: China versus the West, Canadian Journal of Administrative Sciences, 10/2, 167-77.
23. Schein, E. (1992), Organizational Culture and Leadership, Jossey Bass, San Francisco.
24. Sitko – Lutek, A. (2004), Kulturowe uwarunkowania doskonalenia menedżerów, Wydawnictwo UMCS, Lublin.
25. Stern, S., Porter, M.E., Furman, J.L. (2000), The Determinants of National Innovative Capacity, Working paper 7876, Cambridge, Massachusetts, National Bureau of Economic Research.
26. The Global Innovation Index 2012, Stronger Innovation Linkages for Global Growth, edited by Dutta S., INSEAD and the World Intellectual Property Organization (WIPO), 2012, http://www.globalinnovationindex.org/gii/main/fullreport/index.html
27. Trompenaars, F. (1993) Riding the Waves of Culture, Nicholas Brearley.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

SELF-DISCLOSURE ON SOCIAL NETWORK SITES IN ADOLESCENTS: THE EXPLORATORY STUDY OF THAI STUDENTS

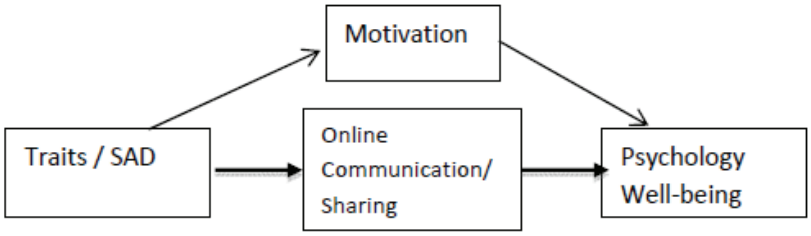
Yupin Patarapongsant, Sasin Graduate Institute of Business Administration, Chulalongkorn University, Sasa Patasala Builing, Phayathai Road, Pathumwan, Bangkok 10330, Thailand

Issariya Woraphiphat[1], Sasin Graduate Institute of Business Administration, Chulalongkorn University, Sasa Patasala Builing, Phayathai Road, Pathumwan, Bangkok 10330, Thailand

ABSTRACT

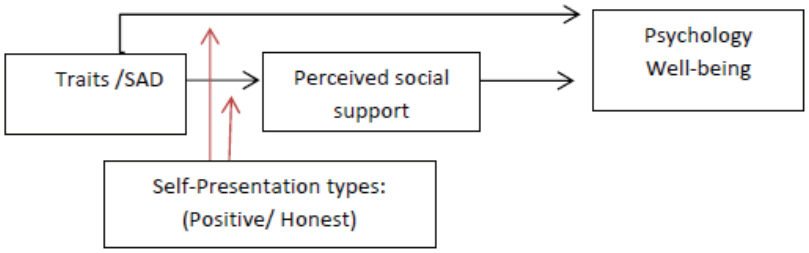
Purpose: *Online media increase popularity among adolescent as they are growing up with the development of technology, particularly "Internet". Adolescent has higher rate of using Internet and email as source of information in comparison to other age group (world value survey collected during 2005-2007). Social Network sites (SNS) received popularity among these adolescents. They are transforming the nature of social relations (Greenfield at al. 2012). Recent studies show the positive side of using SNS such as facebook, which lead to improvement in psychological well being via emotional sharing (Buechel and Berger 2012) and through perceived social support (Kim and Lee 2011). This study aims at extent the current research by examining the effect of how communication and sharing strategies (positive vs. honest) lead to psychology well being among individual from different traits. (Introvert vs. extrovert).*

Theoretical Framework 1



We posit that introvert individuals psychology well being will be enhance by online communication/ sharing. This effect is mediated by their motivation for using social network sits (SNS).

Theoretical Framework 2



We posit that effect of positive self presentation is directly lead to improving psychology well-being, while the effect of honest self presentation is mediated by perceive social support. We predict that the degree of effect is varies on traits of individual.
Design/ Mythology/ Approach: *Participants were high school students from two schools located in different part of Bangkok,*
Thailand. We held a meeting with school research department and inform teacher the procedure. Students need to fill out 7 points, Likert-type format questionnaires and hand in to their class teacher in exchange for a gift. The questionnaire includes the several questions such as; "Motivation for using SNS", which consists of twenty items, which can be divided into 3 subscales including (Self presenting, keep up with trend, information sharing and storage, entertainment, and showoff) with the alpha reliabilities of 0.863, .743, .836, .856, and .839 respectively. (We test for test for the reliability of our instrument, please see more detail in the appendix.)
Finding: *The preliminary analysis shows that participants were 376 students; 210 students from a vocational school in a less affluent area of Bangkok and 166 students from an elite high school in the central business district of Bangkok. 95% of the participants were between 16-17 years old. Participants engage in various social network sites activities including chat, chatroom, bulletin board, blog, social network sites, and online games. The correlation analysis shows association among variables we are interested in such as traits, motivations, self-disclosure, and psychological well-being.*
Limitations: *Since this study was on the exploratory stage. Long-term research programs studying should*
detect the change in adolescent's psychological well-being overtime with respect to the degree of social network sites usage to capture the casual effect.
Implication: *Social Media Marketing received popularity in recent year. Understanding the motivation and consequences of consumer engagement in SNS could help firms design appropriate relationship marketing tools that could involve with consumer self disclosure.*

REFERENCE

1. Adriana M. Manago, Tamara Taylor, and Patricia M. Greenfield (2012)."Me and My 400 Friends: The Anatomy of College Students' Facebook Networks, Their Communication Patterns, and Well-Being. *Development Psychology Vol. 48*
2. Annette M. La Greca and Wendy L. Stone (1993). "Social Anxiety Scale for Children-Revised: Factor Structure and Concurrent Validity." *Journal of Clinical Child Psychology Vol 22.*
3. Carolyn A. Lin (1999). "Online-Service Adoption Liklihood". *Journal of Advertising Research.*

4. Charles Steinfield, Nicole B. Ellison, Cliff Lampe (2008). "Social capital, self-esteem, and use of online social network sites: A longitudinal analysis". *Journal of Applied Developmental Psychology.*
5. Daria J. Kuss, Mark D. Griffiths, Jens F. Binder (2013). "Internet addiction in students: Prevalence and risk factors." *Computer in Human Behavior*
6. Doo-Hee Lee, Seunghee Im, and Charles R. Taylor (2008). "Voluntary Self-Disclosure of Information on the Internet: A Multimethod Study of the Motivations and Consequences of Disclosing Information on Blogs." *Psychology & Marketing Vol. 25.*
7. Eva Bueche and Jonah Berger (2012). "Facebook Therapy: Why Perople Share Self-Relevant Content Online." *Working paper.*
8. Janghyun Kim, Ph.D., and Jong-Eun Roselyn Lee, Ph.d. (2011). "The Facebook Paths to Happiness: Effects of the Number of Facebook Friends and Self-Presentation on Subjective Well-Being." *Cybersychology, Behavior, and Social Networking Vol. 14*
9. John, Deborah Roedder (1999), "Consumer Socialization of Children: A Retrospective Look at Twenty-Five Years of Research," *Journal of Consumer Research, xx,xx.*
10. Kaveri Subrahmanyam, Patricia Greenfield (2008). "Online Communicatoin and Adolescent Relationship". *The Future if Children Vol.18 No.1*
11. Kyughee Kim, Eunjung Ryu, MMi-Young Chon, Eun-Ja Yeun, So-Young Choi, Jeong-Seok Seo, Bum-Woo Nam. (2006). "Internet addiction in Korean adolescents and its relation to depression and suicidal ideation: A questionnaire survey". *International Journal of Nursing Studies.*
12. Laurel Anderson and Deborah Brown McCabe. (2012). "A Coconstructed Wrodl: Adolescent Self-Socialization on the Internet." *Journal of Public Policy & Marketing Vol. 31 (2)*
13. Lin, Carolyn A. (1999, 2000). "online Service Adoption Likelihood". *Marketing Scale Handbook*
14. Mesch, Gustavo S. (2001), "Social relationships and Internet use among adolescents in Israel," *Social Science Quarterly, 82*, 329-340.
15. Michael W. Kraus and Nicole M. Stephens. "A Road Map for an Emerging Psychology of Social Class." *Social and Personality Psychology Compass 6/9 (2012).*
16. Mitja D. Back at al (2010). "Facebook profile reflect actual personality not self idealization". Psychological Science 21(3) 372–374.
17. Patti M. Valkenburg and Jochen Peter (2009). "Social Consequences of the Internet for Adolescents". *Journal of Applied Developmental Psychology*
18. Tiffany A. Penpek, Yevdokiya A. Yermolayeva, Sandra L. Calvert (2009). " College students social networking experiences on Facebook. *Journal of Applied Developmental Psychology 30 (2009) 227 - 238*
19. Zarona Ivcevic and Nalini Ambody (2012). "Personality Impressions From Identity Claims on Facebook" *Psychology of Popular Media Culture Vol. 1*

Appendix I Scales

Question	Scale (Adapted from)	Reliability Test
Part I Internet Usage		
a. Form of Use	"Online service adoption likelihood (1999)", Carolyn A. Lin	
b. Frequency of use	"Adolescents online communication usage", Patti M. Valkenburg (2007)	
c. Motivation of Internet usage (8 items scales)	Marketing Scale Handbook: Refernce, Lin, Carolyn A. (1999, 2000) alpha .91	
Part II Self Disclosure in Social Network		
d. Communication with friends (Private vs. public)	Adapted from "Communication with friends scales" , Adriana M. Manago, Tamara Taylor, and Patricia M. Greenfield (2012)	Alpha = .877 6 items, one component
e. Motivation for Self disclosure Scales	Adapted from "Motivation and consequence for Self disclosure Scales", Soo Hee Lee, Seunghee Im, and Charles R. Taylor (2008)	1. Self presentation .863 (6 items) 2. Keep up with trend .743 (3 items) 3. Info storage sharing .836 (5 items) 4. Entertainment .856 (3 items) 5. Showoff .839 (3 items)
f. Positive self disclosure and Honest self discloser	Adapted from "self presentation scale", Junghyun Kim and Jong Eun Roselyn Lee (2011)	Positive Alpha = .734, 5 items, one component Honest Alpha = .865, 2 items, one component
g. Perceive social support	Adapted from "Multidimensional scale of perceived social support", Zimet, Dahlem, Zimet & Fareley (1988)	Alpha = .853, 6 items (friends) and Alpah = .795, 3 items (family)
h. Consequence for Self disclosure Scales	Adapted from "Motivation and consequence for Self disclosure Scales", Soo Hee Lee, Seunghee Im, and Charles R. Taylor (2008)	1. Relationship management = .886 (4 items) 2. Psychology well being =.901 (3 items) 3. Habitual =.893 (3 items)
Part III Personality/ Trait/ Self esteem/ Social anxiety		
j. Personality (10 items)	Adapted from Hand book of marketing sclaes, William O. Bearden et al. (3rd ediction 2011)	Extravert (5 items) = .749 Aggressive (3 items) = .517 Introvert (2 items) = .416
k. self esteem (10 - items)	Adapted from Rosenberg's self esteem scale (1965)	Alpha =.738 (5 items)
l. social anxiety (Fear of Negativity -FNE, Social avoidance and Distress - SAD)	Adapted from "Social Anxiety Scale for Children-Revise (SASC-R)"Annette M. La Greca and Wendy L. Stone (1993)	SAD New = .85 (4 items) SAD General = .847 (4 items) FNE =.868 (7 items)

Appendix II *Instrumental Testing*

Ten Items Personality Inventories (TIPI) consists of ten items referring traits and characteristic of individual (e.g. Warm, Careless, and Conventional). We can divide into 3 subscales. However, we will focus on two dimensions, "Extrovert (e.g. extraverted, enthusiastic)" and "Introvert (Conventional, reserved)" with Alpha reliabilities of .75 and .42 respectively. ***ii) Social Avoidance and Distress (SAD)*** consists of eight items referring to in group and out group social avoidance, which can divided in to two subscales with alpha of .85 and .847 respectively. ***iii) Self esteem (adapted from Rosenberg, 1965)*** we select 5 items with alpha =.738. ***iv) Communication with friends*** consists of six items referring to how frequent individual communicate with friends n public and private. The alpha reliabilities is 0.877. ***v) Motivation for self-disclosure*** consists of twenty items, which can be divided into 3 subscales including (Self presenting, keep up with trend, information sharing and storage, entertainment, and showoff) with the alpha reliabilities of 0.863, .743, .836, .856, and .839 respectively ***vi) Self Presentation (Adapt from Lee, Im, and Taylor, 2008)*** consists of 7 items, 2 subscales; "Positive self-disclosure" with alpha of .734 and "Honest self disclosure" with alpha of .865. ***vii) Perceive social support (Adapt from Zimet et al., 1988)*** consists of 9 items, 2 subscales; "Friends" with alpha of .853 and "Family" with alpha of .795. ***viii) Psychology Well-being*** consists of 3 items with alpha of .901.

Appendix II Correlation Analysis

Correlations Analysis

		Positive self presentation	Honest self presentation	Perceived social sup. friends	Perceived social sup. family	Consequence Relationship Mng	Consequence PWB	Consequence Habit	FNE	Self Esteem	Trait Extrovert	Trait Agg.	Trait Introvert
Positive self presentation	Pearson Correlation	1	.567**	.426**	.255**	.629**	.514**	.563**	.273**	.352**	.407**	.239**	.183**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.002
	N	277	277	273	277	273	275	274	274	269	276	276	276
Honest self presentation	Pearson Correlation	.567**	1	.230**	.060	.509**	.484**	.538**	.156**	.260**	.235**	.153**	.040
	Sig. (2-tailed)	.000		.000	.250	.000	.000	.000	.003	.000	.000	.003	.442
	N	277	373	367	372	367	371	368	369	363	372	372	371
Perceived social support_friends	Pearson Correlation	.426**	.230**	1	.570**	.441**	.365**	.209**	.053	.441**	.499**	.148**	.137**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.310	.000	.000	.004	.009
	N	273	367	370	369	364	368	365	366	360	369	369	368
Perceived social support_family	Pearson Correlation	.255**	.060	.570**	1	.173**	.184**	-.027	-.034	.374**	.354**	.075	.101
	Sig. (2-tailed)	.000	.250	.000		.001	.000	.610	.515	.000	.000	.147	.050
	N	277	372	369	375	369	373	370	371	365	374	374	373
Consequence Relationship Mng	Pearson Correlation	.629**	.509**	.441**	.173**	1	.783**	.565**	.203**	.402**	.435**	.182**	.196**
	Sig. (2-tailed)	.000	.000	.000	.001		.000	.000	.000	.000	.000	.000	.000
	N	273	367	364	369	370	368	365	366	360	369	369	368
Consequence Psychology well being	Pearson Correlation	.514**	.484**	.365**	.184**	.783**	1	.471**	.191**	.293**	.344**	.155**	.132*
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000	.000	.000	.003	.011
	N	275	371	368	373	368	374	369	370	365	373	373	372
Consequence Habit	Pearson Correlation	.563**	.538**	.209**	-.027	.565**	.471**	1	.220**	.199**	.290**	.196**	.202**
	Sig. (2-tailed)	.000	.000	.000	.610	.000	.000		.000	.000	.000	.000	.000
	N	274	368	365	370	365	369	371	367	361	370	370	369
Fear of Negative Evaluation	Pearson Correlation	.273**	.156**	.053	-.034	.203**	.191**	.220**	1	-.008	.171**	.433**	.260**
	Sig. (2-tailed)	.000	.003	.310	.515	.000	.000	.000		.872	.001	.000	.000
	N	274	369	366	371	366	370	367	372	362	372	371	370
Self Esteem	Pearson Correlation	.352**	.260**	.441**	.374**	.402**	.293**	.199**	-.008	1	.611**	-.026	.226**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.872		.000	.619	.000
	N	269	363	360	365	360	365	361	362	366	365	365	364
Trait Extrovert	Pearson Correlation	.407**	.235**	.499**	.354**	.435**	.344**	.290**	.171**	.611**	1	.212**	.350**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.001	.000		.000	.000
	N	276	372	369	374	369	373	370	372	365	375	374	373
Trait Aggressive	Pearson Correlation	.239**	.153**	.148**	.075	.182**	.155**	.196**	.433**	-.026	.212**	1	.294**
	Sig. (2-tailed)	.000	.003	.004	.147	.000	.003	.000	.000	.619	.000		.000
	N	276	372	369	374	369	373	370	371	365	374	375	373
Trait Introvert	Pearson Correlation	.183**	.040	.137**	.101	.196**	.132*	.202**	.260**	.226**	.350**	.294**	1
	Sig. (2-tailed)	.002	.442	.009	.050	.000	.011	.000	.000	.000	.000	.000	
	N	276	371	368	373	368	372	369	370	364	373	373	374

Appendix III Statistic Summary

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	220	58.5	58.8	58.8
	Male	154	41.0	41.2	100.0
	Total	374	99.5	100.0	
Missing	System	2	.5		
Total		376	100.0		

School

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Vocational	210	55.9	55.9	55.9
	General	166	44.1	44.1	100.0
	Total	376	100.0	100.0	

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	14	2	.5	.5	.5
	15	2	.5	.5	1.1
	16	179	47.6	48.4	49.5
	17	176	46.8	47.6	97.0
	18	11	2.9	3.0	100.0
	Total	370	98.4	100.0	
Missing	System	6	1.6		
Total		376	100.0		

Devices

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	17	4.5	4.6	4.6
	smart phone	132	35.1	35.4	39.9
	computer laptop	224	59.6	60.1	100.0
	Total	373	99.2	100.0	
Missing	System	3	.8		
Total		376	100.0		

Location

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	34	9.0	9.1	9.1
	home	302	80.3	80.5	89.6
	school	12	3.2	3.2	92.8
	internet cafe	27	7.2	7.2	100.0
	Total	375	99.7	100.0	
Missing	System	1	.3		
Total		376	100.0		

Internet Usage

ANOVA

Gender		Sum of Squares	df	Mean Square	F	Sig.
Chat	Between Groups	2.598	1	2.598	.678	.411
	Within Groups	1415.003	369	3.835		
	Total	1417.601	370			
Chatroom	Between Groups	24.497	1	24.497	8.290	.004
	Within Groups	1084.435	367	2.955		
	Total	1108.932	368			
Bullentin board	Between Groups	2.272	1	2.272	.712	.399
	Within Groups	1177.011	369	3.190		
	Total	1179.283	370			
Blog	Between Groups	1.369	1	1.369	.451	.502
	Within Groups	1120.362	369	3.036		
	Total	1121.730	370			
Social network Sites (SNS)	Between Groups	3.100	1	3.100	1.430	.233
	Within Groups	799.919	369	2.168		
	Total	803.019	370			
Online Games	Between Groups	293.554	1	293.554	70.266	.000
	Within Groups	1533.226	367	4.178		
	Total	1826.780	368			
Frequency_Weekdays	Between Groups	4623423.395	1	4623423.395	13.334	.000
	Within Groups	122399938.623	353	346742.036		
	Total	127023362.018	354			
Frequency_Weekends	Between Groups	1712961.417	1	1712961.417	9.785	.002
	Within Groups	58820278.720	336	175060.353		
	Total	60533240.137	337			

ANOVA

School		Sum of Squares	df	Mean Square	F	Sig.
Chat	Between Groups	35.881	1	35.881	9.576	.002
	Within Groups	1390.092	371	3.747		
	Total	1425.973	372			
Chatroom	Between Groups	80.642	1	80.642	28.896	.000
	Within Groups	1029.789	369	2.791		
	Total	1110.431	370			
Bullentin board	Between Groups	104.623	1	104.623	35.965	.000
	Within Groups	1079.254	371	2.909		
	Total	1183.877	372			
Blog	Between Groups	64.167	1	64.167	22.401	.000
	Within Groups	1062.702	371	2.864		
	Total	1126.869	372			
Social network Sites (SNS)	Between Groups	.955	1	.955	.440	.508
	Within Groups	804.965	371	2.170		
	Total	805.920	372			
Online Games	Between Groups	127.046	1	127.046	27.514	.000
	Within Groups	1703.822	369	4.617		
	Total	1830.868	370			
Frequency_Weekdays	Between Groups	811048.560	1	811048.560	2.273	.133
	Within Groups	126326419.864	354	356854.293		
	Total	127137468.423	355			
Frequency_Weekends	Between Groups	759243.867	1	759243.867	4.277	.039
	Within Groups	59994415.571	338	177498.271		
	Total	60753659.438	339			

Report

School	Gender		Chat	Chat room	Bulletin board	Blog	Social network Sites (SNS)	Online Games	Frequency Weekdays (Minutes)	Frequency Weekend (Minutes)
Vocational	Female	Mean	4.5909	3.4351	3.7273	3.3485	5.7121	3.9847	355.5543	293.8703
		N	132	131	132	132	132	131	129	116
		Std. Deviation	1.54798	1.56942	1.58278	1.65306	1.46996	1.87282	412.50249	354.08897
	Male	Mean	4.3836	4.0000	3.8219	3.3288	5.7945	5.4247	850.1408	560.4583
		N	73	72	73	73	73	73	71	72
		Std. Deviation	2.11890	1.86895	1.86594	1.94404	1.72368	1.84027	886.95827	524.96551
	Total	Mean	4.5171	3.6355	3.7610	3.3415	5.7415	4.5000	531.1325	395.9678
		N	205	203	205	205	205	204	200	188
		Std. Deviation	1.77011	1.69890	1.68512	1.75747	1.56132	1.98144	665.18254	445.67245
General	Female	Mean	5.2614	2.3409	2.4545	2.2841	6.1023	2.1250	456.4706	292.9136
		N	88	88	88	88	88	88	85	81
		Std. Deviation	2.08715	1.51533	1.68092	1.63966	1.23213	1.72748	469.54944	358.78643
	Male	Mean	4.9744	3.0769	2.9615	2.7821	5.5769	4.7013	404.4286	309.9130
		N	78	78	78	78	78	77	70	69
		Std. Deviation	2.16809	1.69621	1.76136	1.55127	1.44617	2.21279	531.70190	425.73268
	Total	Mean	5.1265	2.6867	2.6928	2.5181	5.8554	3.3273	432.9677	300.7333
		N	166	166	166	166	166	165	155	150
		Std. Deviation	2.12395	1.63986	1.73263	1.61329	1.35854	2.34823	497.59672	389.75013
Total	Female	Mean	4.8591	2.9954	3.2182	2.9227	5.8682	3.2374	395.6379	293.4769
		N	220	219	220	220	220	219	214	197
		Std. Deviation	1.80895	1.63533	1.73538	1.72503	1.39008	2.02921	437.78208	355.11456
	Male	Mean	4.6887	3.5200	3.3775	3.0464	5.6821	5.0533	628.8652	437.8511
		N	151	150	151	151	151	150	141	141
		Std. Deviation	2.15773	1.83449	1.85739	1.76763	1.58481	2.06533	763.34704	493.55441
	Total	Mean	4.7898	3.2087	3.2830	2.9730	5.7925	3.9756	488.2718	353.7040
		N	371	369	371	371	371	369	355	338
		Std. Deviation	1.95738	1.73592	1.78529	1.74118	1.47320	2.22802	599.01841	423.82055

Finding: Vocational school students use online communication tools in public space such as bulletin board, blog, online game significantly more than general school students. They also use internet at a significant higher level during weekends.

Internet Motivation

ANOVA

School		Sum of Squares	df	Mean Square	F	Sig.
keep myself company	Between Groups	15.086	1	15.086	6.928	.009
	Within Groups	814.443	374	2.178		
	Total	829.529	375			
keep yourself from being bore	Between Groups	4.377	1	4.377	2.282	.132
	Within Groups	715.261	373	1.918		
	Total	719.637	374			
get advice	Between Groups	60.262	1	60.262	27.791	.000
	Within Groups	806.650	372	2.168		
	Total	866.912	373			
forget about your problems	Between Groups	137.224	1	137.224	50.487	.000
	Within Groups	1013.806	373	2.718		
	Total	1151.029	374			
tune out what's going on around you	Between Groups	42.363	1	42.363	14.234	.000
	Within Groups	1113.074	374	2.976		
	Total	1155.436	375			
relax	Between Groups	.390	1	.390	.226	.635
	Within Groups	641.791	372	1.725		
	Total	642.182	373			
make friends with people who share the same interests on the network	Between Groups	160.857	1	160.857	58.431	.000
	Within Groups	1026.839	373	2.753		
	Total	1187.696	374			

Report

School		keep myself company	keep yourself from being bore	get advice	forget about your problems	tune out what's going on around you	relax	chat with people who share the same interest
Vocational	Mean	5.3190	5.5789	5.2115	4.6938	3.4952	5.7560	5.3541
	N	210	209	208	209	210	209	209
	Std. Deviation	1.40339	1.31732	1.38434	1.62966	1.76420	1.32025	1.38640
General	Mean	4.9157	5.3614	4.4036	3.4759	2.8193	5.6909	4.8373
	N	166	166	166	166	166	165	166
	Std. Deviation	1.56248	1.46538	1.57626	1.67224	1.67437	1.30486	1.77629
Total	Mean	5.1410	5.4827	4.8529	4.1547	3.1968	5.7273	5.1253
	N	376	375	374	375	376	374	375
	Std. Deviation	1.48731	1.38714	1.52452	1.75431	1.75532	1.31212	1.58966

Finding: Vocational school students use online communication tools more than general school students significantly to in order to get advice or to escape from problem or surrounding environment, as well as making friends.

Analysis by Personality Traits and SAD

ANOVA

SAD General		Sum of Squares	df	Mean Square	F	Sig.
keep myself company	Between Groups	13.047	1	13.047	5.954	.015
	Within Groups	815.156	372	2.191		
	Total	828.203	373			
keep yourself from being bored	Between Groups	11.235	1	11.235	5.904	.016
	Within Groups	705.961	371	1.903		
	Total	717.196	372			
get advice	Between Groups	21.339	1	21.339	9.390	.002
	Within Groups	840.823	370	2.272		
	Total	862.161	371			
forget about your problems	Between Groups	45.523	1	45.523	15.296	.000
	Within Groups	1104.145	371	2.976		
	Total	1149.668	372			
tune out what's going on around you	Between Groups	49.119	1	49.119	16.536	.000
	Within Groups	1105.020	372	2.970		
	Total	1154.139	373			
relax	Between Groups	.194	1	.194	.112	.738
	Within Groups	638.460	370	1.726		
	Total	638.653	371			
make friends with people who share the same interests on the network	Between Groups	33.362	1	33.362	10.727	.001
	Within Groups	1153.807	371	3.110		
	Total	1187.169	372			

Report

Percentile Group of SADNew2		keep myself company	keep yourself from being bore	get advice	forget about your problems	tune out what's going on around you	relax	chat with people who share the same interest
0	Mean	5.0120	5.3655	4.6855	3.9116	2.9357	5.7177	5.0403
	N	249	249	248	249	249	248	248
	Std. Deviation	1.58999	1.47799	1.55788	1.75754	1.69317	1.35611	1.57870
1	Mean	5.4080	5.7339	5.1935	4.6532	3.7040	5.7661	5.2960
	N	125	124	124	124	125	124	125
	Std. Deviation	1.23194	1.15547	1.40080	1.65792	1.78264	1.22381	1.61157
Total	Mean	5.1444	5.4879	4.8548	4.1582	3.1925	5.7339	5.1260
	N	374	373	372	373	374	372	373
	Std. Deviation	1.49010	1.38850	1.52443	1.75798	1.75904	1.31204	1.59222

Finding: Students with higher Social Avoidance Distress are motivated to use online communication tools for getting advice, tune out problem and surrounding and to making friends at a significant higher level than students with low SAD.

ANOVA

Introvert		Sum of Squares	df	Mean Square	F	Sig.
keep myself company	Between Groups	11.566	1	11.566	5.291	.022
	Within Groups	813.205	372	2.186		
	Total	824.770	373			
keep yourself from being bore	Between Groups	8.314	1	8.314	4.364	.037
	Within Groups	706.823	371	1.905		
	Total	715.137	372			
get advice	Between Groups	15.904	1	15.904	6.931	.009
	Within Groups	848.964	370	2.294		
	Total	864.868	371			
forget about your problems	Between Groups	.883	1	.883	.286	.593
	Within Groups	1146.709	371	3.091		
	Total	1147.592	372			
tune out what's going on around you	Between Groups	7.166	1	7.166	2.324	.128
	Within Groups	1146.973	372	3.083		
	Total	1154.139	373			
relax	Between Groups	2.212	1	2.212	1.286	.258
	Within Groups	636.441	370	1.720		
	Total	638.653	371			
make friends with people who share the same interests on the network	Between Groups	11.919	1	11.919	3.769	.053
	Within Groups	1173.299	371	3.163		
	Total	1185.217	372			

Report

Percentile Group of Trait_introvert		keep myself company	keep yourself from being bore	get advice	forget about your problems	tune out what's going on around you	relax	chat with people who share the same interest
0	Mean	5.0159	5.3785	4.7068	4.1160	3.0956	5.6800	5.0120
	N	251	251	249	250	251	250	250
	Std. Deviation	1.50457	1.41851	1.55231	1.69293	1.70846	1.35089	1.65372
5.3902	5.6967	5.1463	4.2195	3.3902	5.8443	5.3496		
	N	123	122	123	123	123	122	123
	Std. Deviation	1.42365	1.29774	1.43540	1.88409	1.84939	1.22657	1.43140
Total	Mean	5.1390	5.4826	4.8522	4.1501	3.1925	5.7339	5.1233
	N	374	373	372	373	374	372	373
	Std. Deviation	1.48700	1.38651	1.52682	1.75640	1.75904	1.31204	1.58989

Extrovert

Report

Percentile Group of Trait_extravert		keep myself company	eep yourself from being bore	get advice	forget about your problems	tune out what's going on around you	relax	chat with people who share the same interest
0	Mean	4.8880	5.2932	4.7258	4.0683	3.1960	5.5823	4.8193
	N	250	249	248	249	250	249	249
	Std. Deviation	1.45738	1.37019	1.49947	1.71314	1.70682	1.29603	1.59494
1	Mean	5.6480	5.8640	5.1120	4.3280	3.2080	6.0242	5.7360
	N	125	125	125	125	125	124	125
	Std. Deviation	1.42702	1.35208	1.55136	1.83504	1.85914	1.30330	1.40359
Total	Mean	5.1413	5.4840	4.8552	4.1551	3.2000	5.7292	5.1257
	N	375	374	373	374	375	373	374
	Std. Deviation	1.48927	1.38878	1.52592	1.75665	1.75658	1.31334	1.59178

Appendix IV Regression Analysis

1. Personality Traits (Extrovert), Communication on fb, Motivations, Perceived support, PWB (relationship management)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.763[a]	.583	.576	.64326026

a. Predictors: (Constant), Communication with friends on fb, make friends with people who share the same interests on the network,Trait_Extrovert, Motivation_entertainment, Perceived social support_friends, Motivation_show off

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	200.599	6	33.433	80.799	.000[a]
	Residual	143.583	347	.414		
	Total	344.182	353			

a. Predictors: (Constant), Communication with friends on fb, make friends with people who share the same interests on the network, Trait_Extrovert, Motivation_entertainment, Perceived social support_friends, Motivation_show off
b. Dependent Variable: Consequence_Relationship Mng

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.480	.107		-4.482	.000
	Motivation_entertainment	.269	.043	.274	6.244	.000
	Motivation_show off	.253	.046	.256	5.495	.000
	make friends with people who share the same interests on the network	.113	.022	.206	5.037	.000
	Perceived social support_friends	.092	.042	.093	2.169	.031
	Trait_Extrovert	.140	.042	.142	3.315	.001
	Communication with friends on fb	.094	.047	.095	2.015	.045

a. Dependent Variable: Consequence_Relationship Mng

2. SAD, Motivations, Perceived support, PWB (relieve stress)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.684[a]	.468	.459	.72747632

a. Predictors: (Constant), SAD_Ingroup, Communication with friends on fb, make friends with people who share the same interests on the network, Perceived social support_friends, Motivation_entertainment, Motivation_show off

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	162.879	6	27.147	51.295	.000[a]
	Residual	185.228	350	.529		
	Total	348.107	356			

a. Predictors: (Constant), SAD_Ingroup, Communication with friends on fb, make friends with people who share the same interests on the network, Perceived social support_friends,
Motivation_entertainment, Motivation_show off

b. Dependent Variable: Consequence_Psychology well being

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.367	.122		-3.015	.003
	Motivation_entertainment	.354	.049	.357	7.159	.000
	Motivation_show off	.193	.054	.195	3.594	.000
	make friends with people who share the same interests on the network	.084	.025	.153	3.311	.001
	Perceived social support_friends	.100	.045	.102	2.220	.027
	Communication with friends on fb	.093	.051	.094	1.806	.072
	SAD_Ingroup	.086	.042	.087	2.057	.040

a. Dependent Variable: Consequence_Psychology well being

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

DEVELOPMENT OF CLOUD VIRTUALIZATION TECHNOLOGY AND ITS APPLICATION IN MANUFACTURING MANAGEMENT SYSTEM- A CASE STUDY

Shang-Liang Chen1*, National Cheng Kung University, Institute of Manufacturing Information and Systems
***Email: slchen@mail.ncku.edu.tw**

Cheng-Hung Kuo 1, National Cheng Kung University, Institute of Manufacturing Information and Systems

Ying-Han Hsiao1, National Cheng Kung University, Institute of Manufacturing Information and Systems

Sin-Ru Wang1, National Cheng Kung University, Institute of Manufacturing Information and Systems

Yun-Yao Chen1, National Cheng Kung University, Institute of Manufacturing Information and Systems

Chiang Hsu2, Chang Jung Christian University, Department of Business Administration

ABSTRACT

The aim of this study is to propose a cloud virtualization technology infrastructure with an implementation of a case study. Applications of cloud computing in manufacturing and application of virtualization technology in the manufacturing literatures are reviewed in this paper. A manufacturing model is proposed based on cloud virtualization technology. An application scenario of the manufacturing management system based on cloud is developed and evaluated. This cloud-based manufacturing management system model to be proposed here includes infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS). This cloud-based manufacturing management system based on real manufacturing scenario is implemented. Three virtualization technologies are adopted to make the system maintained on different operating systems. For evaluation of the developed system, each verified user accessed the services with portable devices in various operating

systems. The developed system was verified with various windows-based operating systems. The experimental results show the function of the developed system is workable.

Keywords：Virtualization; Virtual machine; Virtual Application; Virtual USB Device; Cloud Manufacturing Management System;

INTRODUCTION

Traditionally, enterprises deploy own manufacturing management systems in almost every computers in their firm. Enterprises encountered two issues. First, when the systems need to be updated, IT staff should reinstall the latest version in all computers. Second, these systems are also limited to specific operating systems, which cause it difficult to deploy and manage. For example, every Windows-based computers need to be reinstalled the latest software version and cannot install Mac-based software. Therefore, this study develops virtual application to solve above problem. However, using virtual application can't access the USB device in some occasions. Take logistic inventory system as an example, staff usually uses RFID reader for cargo inventory. Normally, RFID readers are connected to computers through USB ports, which cause another issue that virtual applications on virtual machines cannot directly connected to local computer USB ports. An USB virtualization solution based on virtual technology is also proposed in this research to solve the issue.

LITERATURE REVIEW

Applications of cloud computing in logistics

In recent years, many scholars have proposed the cloud technology based on the innovative service model of logistics [2, 3]. Some studies are introduced the wireless radio frequency technology. For example, some researches applied RFID and Zigbee to develop logistic management systems [4, 5]. Its achievement is to make an automatic inventory and information access that can help the development of logistics cloud.

Zhiying Zhou et al. proposed a three-layer wisdom logistics model, including infrastructure layer, application layer, and service provider layer. In the infrastructure layer, there are hardware resources and software resources which support the platform. It is divided into public cloud and private cloud. Most of the low security data of small and medium-sized enterprises can be allocated in the public cloud by purchasing data warehouse storages. Therefore, it can avoid duplicate development and waste of resources. The application layer

is worked as software. In this layer, the users can design and operate cloud services. The service provider layer provides cloud computing on the basis of the new business model. The cloud software can be revised based on user demand [6]. According to the study, the cloud computing can be applied in the logistics system in real scenarios.

Shang-Liang Chen [7] et al. proposed the architecture of the logistics management system based on SaaS concept. As shown in Figure 1, the system is divided into four layers: physical resource layer, SaaS service pool layer, middleware layer and service-oriented architecture layer. The cloud architecture installs the functions of the service module, and the application can call service on the cloud to achieve the concept of computing cloud. It is necessary to install the application in local computer and cannot get the services in different devices. Therefore, this study improves the defects, extends the architecture, and develops the systems.

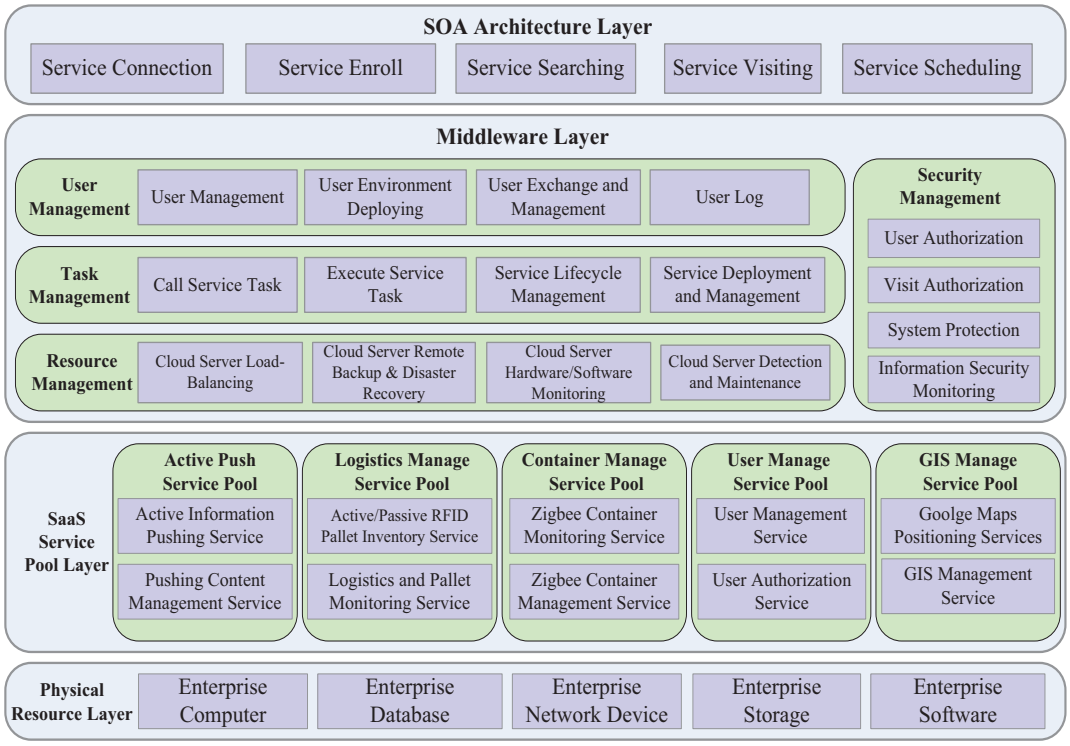


Figure 1. SaaS architecture of logistic management system [7]

Application of virtualization technology

Xing Wang [8] proposed the cloud-computing based logistic information network and offers a brand-new mode in hardware environment construction, software development, network platform management. It can reduce the investment of the initial stages of information technology for the small and medium-sized logistics enterprises. The logistics informatics network is divided into four layers: base layer, support layer, service layer and logistics information business layer. The first layer includes hardware facilities (telecommunication network, network equipment, computer hardware, logistics facilities) and logistics information standards (product electronic code, EDI standards). The second layer is support layer which is a covering the entire supply chain. It includes database, certification, and data exchange. The third layer is the logistics information services layer including the operation of logistics information platform, the development platform and service Platform. The fourth layer is logistics information business layer. It is constituted by warehouse management system, transportation management system, customs system, and order management system. It is used to achieve high-level information processing and handling. According to the architecture, the system is extended and implemented in this study.

THREE-LAYER VIRTUALIZATION INFRASTRUCTURE

Architecture of Three-layer Virtualization Infrastructure

In this study, the architecture of virtualization is divided into three layers, Virtual Machine, Desktop Virtualization, Application Virtualization, and USB Device Virtualization, as shown in Figure 5, and explained as follows:

Layer 1, Virtual Machine (VM): hardware virtualization technology is applied to the cloud server. Several virtual machines are created for installing the different operation systems. For example, WIN XP, WIN 7, WIN 8, WIN Server and Linux, etc..

Layer 2, Desktop Virtualization (DV) and Application Virtualization (App-V): users can select the operating system to connect to the cloud server through various devices. For example, notebook, PC, and mobile device.

Layer 3, USB Device Virtualization (UDV): when USB device plugged in to the local computer, it will create a virtual com port to the virtual machine. Normally, remote services in virtual machines are unable to access local USB comports. Our UDV solutions provide users a way of accessing services in virtual machines and receiving/transmitting from local USB comports.

The three-layer virtualization technology is developed in this study. The end user device can connect to the cloud to use different operating system. The end user can use virtual application in different operating system.

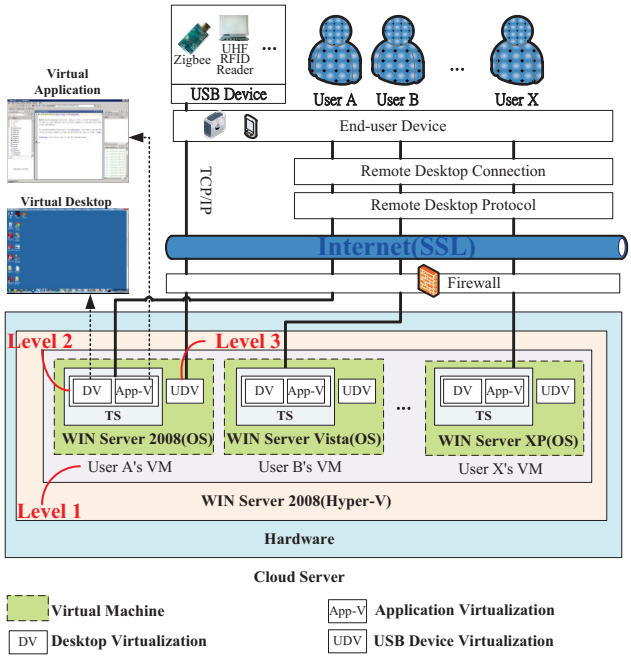


Figure 5. Architecture of 3-Layer Virtualization Infrastructure

Server virtualization

The Para Virtualization is adopted in this study. Hyper-V is adapted to construct virtual machines in the operating system of Windows Server 2008. Three physical machines are divided and virtualized to eleven virtual machines. Five of the virtual machines are used to construct virtual desktop. Four of the virtual machines are deployed the cloud service pool. One of the virtual machines is used as Active Directory (AD) server. Two of the virtual machines are cloud load balancing servers. All the virtual machines add into the same domain. In this case, AD services can manage the virtual machines and user identity verification. This study introduces “Integration Services” into virtualization of operating system. It makes different operating systems to communicate with the Hypervisor. Then, the virtual machines can connect to the hardware. For example, Network Interface Card (NIC) and Small Computer System Interface (SCSI).

Desktop and Application Virtualization

This study adopts Remote Desktop Protocol (RDP) to access virtual desktop [9]. Applications are installed in loud servers. And AD server will provide different software for different users based on limits of authority. A web interface is designed as a platform to provide virtual desktop service and virtual application service. The users can connect to the cloud web server to access the virtual services. It is convenient to use the applications in the local computers. The web interface includes the virtual application (Remote App) and virtual desktop (Remote Desktop). The web page is developed with ASP.NET and ActiveX to connect to the Terminal Service (TS) on the cloud. For information security, the application uses Active Directory (AD) to verify the user's identity and his authority for that application. When the users login to the web page of Remote App, it shows the applications available. The remote control function is designed to show the accessibility of disk drivers, printers, and clipboard software shown in Figure 6.

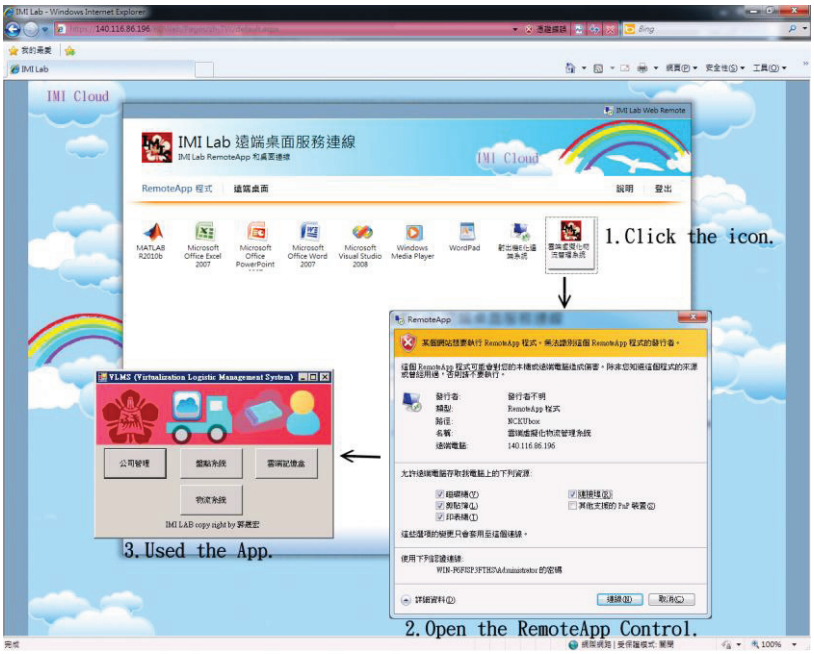


Figure 6. Virtual service (Through web browser)

USB device Virtualization

WIN Server 2008 virtualization services can access data through local USB devices. In pervious researches proposed by many researches, virtual machines are unable to access data from USB devices connected to computers. For solving the issue, this study design and implement an USB device transmission module, which can transfer data from USB devices

(connected with local computers) to virtual machines, named Virtual USB (V-USB). Both the local personal computer and the virtual machine should install this V-USB module which can access data of USB devices from the local part to the virtual machines through the TCP/IP connection, as shown in Figure 7.

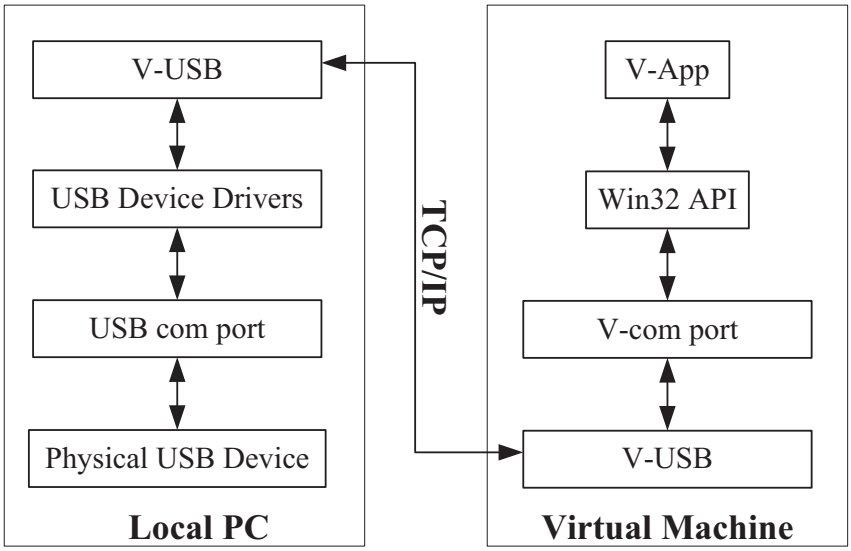


Figure 7. Architecture of virtual USB device

CASE STUDY

Implementation of CLMS based on 4-Layer Virtualization Model

The logistics cloud is proposed in this study and the virtualization technology makes the applications easier to manage and deploy in the cloud. The users can use different operation systems and get the latest cloud service with end-user devices.

1 Application scenario of CLMS

The cloud logistics management system can be applied in different factory. For example, a company divides into factory A, factory B …factory N, as shown in Figure 2. The goods inventory of factory can connect to the virtual server on the cloud through the internet. When the staffs make an inventory, the system needs to connect the hardware devices. For example, UHF RFID Reader and Zigbee ,as shown in Figure 2. Therefore, the system uses the USB device virtualization to access the local USB device. Then the system can serve as a local application, and it can simply be used by any browsers through the internet. The cell phones send GPS signals to any readable device at all times. It aims to make the users can monitor the status of goods and vehicles with the end user device (For example, Table PC

and PDA) when transported.

Figure 2. Application scenarios of CLMS

2 Model of CLMS

The six-layer logistics model of this study is shown in Figure 3. It includes Physical Resource Layer, Support Layer, Virtualization Layer, Information Layer, End Device layer, and USB Hardware Layer. The six-layer model is explained as follows:

1. Physical Resource Layer: physical hardware of the cloud includes server, network equipment and data storage, etc..
2. Support Layer: includes database, certification, data encryption, cloud service pool and data exchange, etc..
3. Virtualization Layer: implementation of cloud virtualization technology includes virtual machine, virtual desktop and virtual application, etc..
4. Information Layer: provides the related information of logistics management.

5. End Device layer: user devices. For example, PC, notebook, PDA or tablet computers, etc..
6. USB Hardware Layer: it contains all the user-side-connected devices. For example, RFID UHF or HF inventory equipment. And the cloud application can call the uses-side hardware devices based on USB device virtualization.

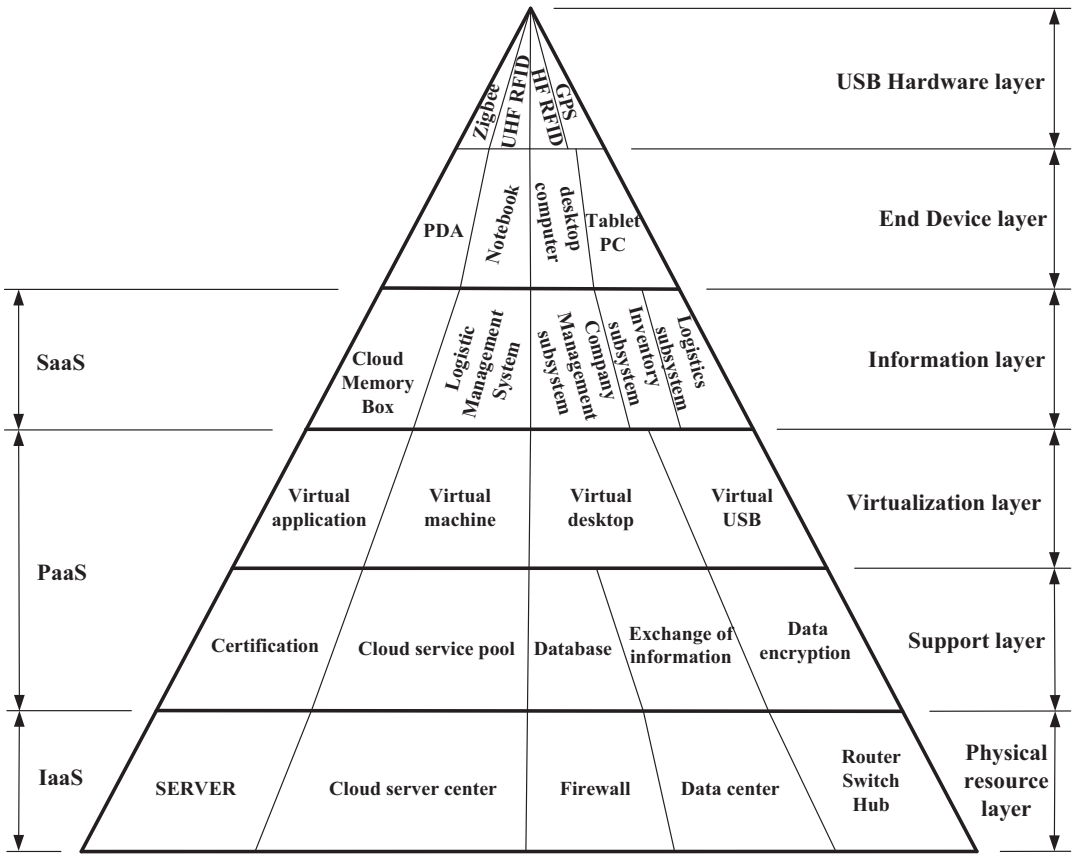


Figure 3. Model of CLMS

3 Architecture of CLMS

In the cloud architecture, the system of this study can be accessed in two ways:

1. Web Browser. For example, Internet Explorer.
2. Application. For example, Remote Desktop.

The above ways are accessed through the internet. The system architecture of this study is shown in Figure 4 and explained as follows:

1. Virtualization architecture: includes virtual operating system, virtual desktop, virtual application, and virtual USB.
   (1) virtual operating system: WIN server 2008, WIN 7, and XP, etc..
   (2) virtual desktop: open and perform the operating system through the internet.
   (3) virtual application：includes cloud logistics management system, Microsoft Office, and MatLab 2010, etc..
   (4) virtual USB: through the USB device virtualization the virtual application can access local USB devices.
   (5)
2. Cloud load balancing: includes cloud load balancing monitoring platform, and cloud load balancing distribution platform.
3. Cloud service pool: provides active message delivery services, logistics management services to the cloud, login service, and GPS location services.
4. Virtualization Management System: responsible for the management server of the entire cloud. For example, add a server, add the VM, and install and release of the virtualization application, etc.
5. Cloud Logistic Management System: responsible for the management of the logistics information. For example, inventory of goods, cargo shipments, monitoring of cargo locations and other services.

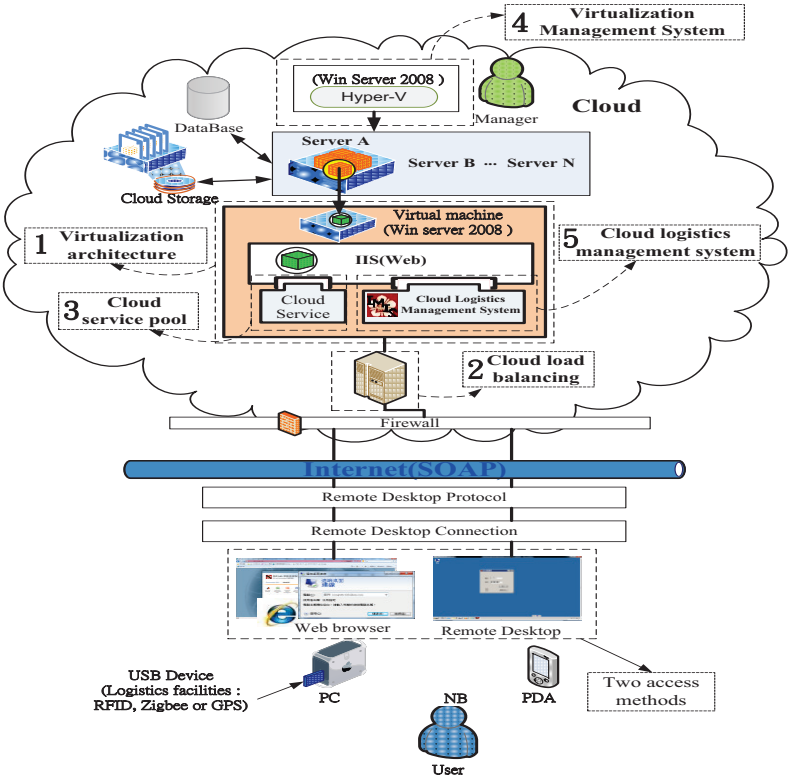


Figure 4. Architecture of CLMS

4 Implementation of CLMS

The cloud-based logistic management system in this research was implemented with a case study CLMS. CLMS has three major subsystems, including company management subsystem, inventory subsystem and logistics subsystem. The company management subsystem is to manage the basic information of the company. The inventory subsystem is to make an automatic inventory for the goods, establish the information of goods and access USB hardware device information. For example, UHF/HF RFID reader, Zigbee and GPS. The logistics subsystem is responsible for displaying the real-time information of goods outside. For example, the logistics subsystem uses the GPS positioning to track current positions of goods on vehicles equipped with GPS devices.

This study uses the Virtual USB to read the information of the local computer RFID UHF reader device within the inventory subsystem, as shown in Figure 8. COM9 is a virtual com port which redirecting local USB device (RFID UHF reader) on the cloud.

The data of this RFID system is received with four antennas signals. The information of the pallet will be sent into the system. For example, there are ten lamps placed in the pallets belongs to the TYC company, etc.

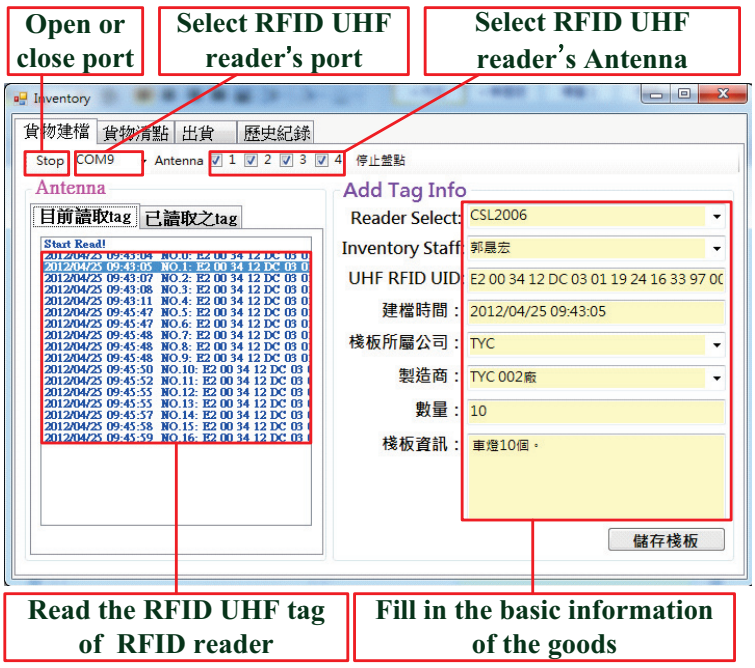


Figure 8. Inventory subsystem – Filling basic information of pallet

When new pallet information is created, the users can inventory the goods of the pallet. And the system will prompt the number of the goods. The users determine whether the information is correct or not and save it. In the shipping screen, the users can choose which pallets to ship, transmit, and display the goods.

The logistics subsystem can read the latitude and longitude of GPS and display the current location of users. It also shows the destination in the screen. The recipients need to sign the signature, and the system sends the E-mail or SMS to the customers. The customers will receive the mail to identify whether the signature and the goods are correct or not.

SYSTEM EVAUATION

Notebooks, tablet pc and mobile devices are tested with systems in this study. The specifications of hardware and software within system tests are shown in Table 1. The functions (includes virtual desktop, virtual application, and cloud logistic management system) are all tested with the system.

Table 1. Specifications of hardware and software within the system tests

Hardware Name	Hardware Type	Operating System
ASUS A42J	Notebook	WIN 7
SAMSUNG SGH-i908	mobile device	WIN mobile 6.1
Surface for Windows 8 Pro	tablet pc	WIN 8

The information of the testing systems is shown in Table 2. The tests are normal in the notebooks and tablet pc. The mobile device cannot connect to the RFID reader and Zigbee etc.. Therefore, the mobile device cannot support most of functions in the RDP and the function of virtual USB. But it can display the information for the managers to make decisions.

Table 2. Comparison of various system tests

		ASUS A42J (WIN 7)	SAMSUNG SGH-i908 (WIN mobile 6.1)	Surface for Windows 8 Pro (WIN 8)
Virtual desktop	WIN XP	✓	✓	✓
	WIN 7	✓	✓	✓
	WIN 8	✓	✓	✓
	WIN Server 2008	✓	✓	✓
	Linux	✓	✓	✓
Virtual application		✓	×	✓
Cloud logistic management system		✓	×	✓
Virtual desktop's	Application	✓	✓	✓
	Cloud logistic management system	✓	✓	✓
	Virtual USB	✓	✓	✓

CONCLUSIONS

In this paper, a cloud virtualization technology infrastructure is proposed with an implementation of a case study: cloud-based logistics management system (CLMS) based on real logistic scenario. Contributions of this research are listed as follows:

1. Applications of cloud computing in logistics and application of virtualization technology literatures are reviewed in this paper.
2. A logistics model is proposed based on cloud virtualization technology. A three-layer virtualization technology is designed with three main solutions for real logistic scenario. Cloud virtual machines can access local USB devices based on our solutions.
3. An application scenario of the logistics management system based on cloud is developed and evaluated.

The results show the system can manage and install the application on different operating systems. The developed system was verified with various windows-based operating systems. The experimental results show the function of the developed system is workable.

REFERENCES

1. "UN: worldwide internet users hit two billion, cellphone subscriptions top five billion", available at: http://www.engadget.com/2011/01/28/un-worldwide-internet-users-hit-two-billion-cellphone-subscript/ (accessed 12 October 2012).
2. Wang, X., Li, W., Zhong, Y., Zhao, W. (2012), "Research on cloud logistics-based one-stop service platform for logistics center", in Proceedings of IEEE 16th International Conference on Computer Supported Cooperative Work in Design (CSCWD), 2012, pp.558-563.
3. Zhang L., Li, J., Yu, M. (2006), "An Integration Research on Service-oriented Architecture (SOA) for Logistics Information System", in Proceedings of IEEE International Conference on Service Operations and Logistics, and Informatics (SOLI '06), 2006, pp. 1059-1063.
4. Jiang, B., Ma, L., Xu, J. (2010), "Research of the collection system of logistics management based on RFID&ZigBee technology", in Proceedings of International Conference on Computer Application and System Modeling (ICCASM), Taiyuan, 2010, pp. 526-529.
5. De La Cruz, A.M.L., Veeke, H. P M., Lodewijks, G. (2007), "Applicability of RFID in the prognostics of logistic systemis", in Proceedings of IEEE International Conference on Service Operations and Logistics, and Informatics, 2007, pp.1-5.
6. Zhou, Z., Lv, D. (2011), "Wisdom Logistics Based on Cloud Computing", in Proceedings of International Conference on Applied Informatics and Communication, 2011, pp. 640-646.
7. Chen, S.L., Chen, Y.Y. (2011), "Design and Implementation of a Global Logistic Tracking System Based on SaaS Cloud Computing Infrastructure", Journal of System and Management Sciences, Vol. 1, No. 1, pp. 85-96.
8. Wang, X. (2011), "Analysis on Cloud Computing-based Logistics Information Network Mode", in Proceedings of Seventh International Conference on Computational Intelligence and Security, 2011, pp.1286-1289.
9. "Remote Desktop Protocol", available at: http://msdn.microsoft.com/en-us/library/windows/desktop/aa383015(v=vs.85).aspx (accessed 22 January 2013).

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

MANAGING KNOWLEDGE TO ENHANCE THE PERFORMANCE OF THE GRASSROOTS TECHNOLOGICAL INNOVATION FOR THAI SMES

Somchai Numprasertchai, Faculty of Engineering, Kasetsart University, snp@ku.ac.th

Haruthai Numprasertchai*, Faculty of Business Administration, Kasetsart University, haruthai.p@ku.ac.th

ABSTRACT

It is widely recognized that SMEs play significant role in driving the country's economy. Thai SMEs as well are heart of the Thailand's economy. Numbers of Thai technological SMEs applies knowledge management (KM) to enhance their innovation capability. This qualitative research, applying a case study method, aims to investigate the practices of knowledge management towards the grassroots innovation of Thai technological SMEs.

The research found that the successful Thai SMEs integrated both internal knowledge, namely technical knowledge, and the external knowledge related to the markets, and the needs of their target customers in inventing product or service innovation. Knowledge management facilitates the Thai entrepreneurs to create and select the right choice for innovation. Knowledge creation and integration help increasing the efficiency of the design and innovation management process. In addition, collaborations from their business alliances help promoting their innovations to the markets. Accordingly, knowledge management indeed supports the efficient innovation management process to Thai SMEs.

Keywords: Knowledge management, Grassroots innovation, Thai SMEs

* *Corresponding author*

INTRODUCTION

Future growth must increasingly come from innovation-induced productivity growth (OECD, 2010). This statement is also true for SMEs around the world. In Thailand, numbers of SMEs which are in the field of information technology has built a lot of technological innovations. Most of these innovations, however, are grassroots innovation, applying simple but locally practical technology. Their value is that they all well respond to the needs of the customers. On the other hand, with the uncomplicated technological development, their innovative products are easy to imitate by competitors of the same size. In the meantime, the large-scale business ignores such a grassroots innovation because it is incapable to efficiently serve a huge demand in the markets and it generates unattractive incomes.

In Thailand according to the official report for year 2011-2012 of the Office of Small and Medium Enterprise Promotion, there were 2,652,854 SMEs in 2011, contributing to the 10.9 million employments which accounts for 83.89% of the total employment. However, number of constraints exist for the SMEs, for example, the lack of experts, capital, machines, and especially knowledge to develop new products and sustain its standard quality. This causes SMEs to be incompetent with the large-scale industry in the field.

Innovation management process is defined as the ability of people to manage and control the factors that drive the innovation processes (Tuominen, Piippo, Ichimura, and Matsumoto, 1999). Basically, the innovation management process is a set of processes of enhancement for commercialization or utilizing of an innovative product, process or service.

In an economy increasingly based on knowledge and innovation, the development of fully functioning knowledge networks and markets can have a significant impact on the efficiency and effectiveness of innovation (OECD, 2010). A knowledge management system (KMS) is considered as an effective management tool that focuses on utilizing the knowledge for enhancing the organizational performance (Matensson, 2000). It plays a critical role in creating innovation and thus is important for the organization's survival and maintenance of competitive advantage (Numprasertchai and Igel, 2004, Numprasertchai, Kanjanasanpetch and Numprasertchai, 2009). The use of KM leading to innovation is found relative to increasing new products and service development within the organization (McAdam, 2000). Applying KMS in SMEs would help an entrepreneur to enhance his or her innovative capability under such constraints. As a matter of fact, KMS can reduce SMEs' weaknesses and could be done at low cost.

Accordingly, with a dominant role in a country's economy, the strengthening of the competitiveness of SMEs is crucial. SMEs need to improve its internal process of new product development (NPD) and make it aligned with the product innovation.

RESEARCH OBJECTIVES

This research aims to explore the current knowledge management practices of Thai SMEs especially the technological SMEs. The reason to focus on Thai technological SMEs is that this type of SMEs involves directly with the grassroots innovation and it is a major group of non-agricultural sector. It involves both manufacturing and service sector, each accounting for approximately 30% of the Thai GDP (Office of Small and Medium Enterprise Promotion,

2012). The obtained information is then integrated to develop a knowledge management model that can be applied for Thai technological SMEs in implementing their grassroots innovation.

RESEARCH METHODOLOGY

To investigate in-depth information about the knowledge management practices in the innovation management process of Thai SMEs, a qualitative research were conducted, using multiple case studies. The reason for this approach is that there is an unclear boundary between knowledge management practices and the innovation management process in Thai technological SMEs. Four cases of Thai technological SMEs were selected based on the two selection criteria as the following.

1) It must be Thai SMEs with grassroots technological innovation.
2) It must be a successful Thai SMEs in terms of financial performance and marketable products.

The research followed the following steps shown in Figure 1.

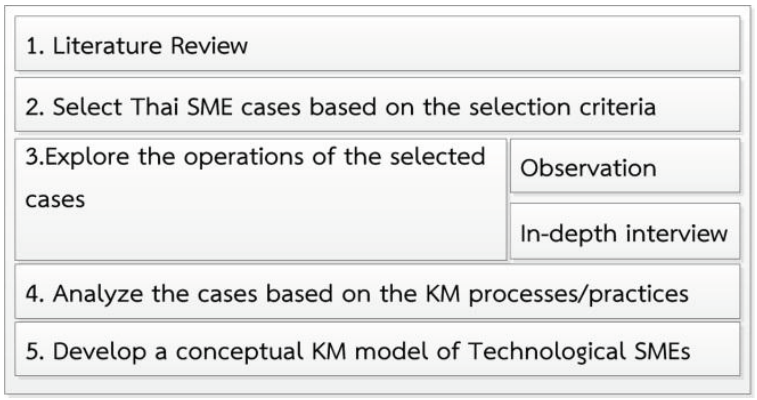


Figure 1 Steps for the research

An in-depth interview was used as a tool for data collection. It was conducted with the selected SME management, staffs and business partners. Due to the requests of the informants to keep the name of the company anonymous, the cases under the study are named as SME_A, SME_B, SME_C, and SME_D respectively. In addition to the interview, observation by the researchers is also included to gather related information.

Results and Discussion

Based on the interviews and observations, the results are presented in 3 sections: overview of each SME, knowledge management concepts in innovation management process of each SME, and knowledge management model for grassroots innovation in Thai technological SMEs.

Overview of the SMEs as the Case Studies

Overview of SME_A: It has been operated since 1997. Its service mainly relies on information technology and internet network. At the beginning, there were only four staffs and some of them were undergrad engineering students. The main strategy that was adopted was creating new service innovation for its members as well as maintaining the customer relationship. At present, SME_A provides a knowledge portal service mainly through an e-service. Its members can create, share, and exchange knowledge whereas the non-members can only read and share their viewpoints but they are not allowed to create or add any issues to the system. With this service, SME_A connects more than 600,000 visitors per day. Based on the figures of the previous years from 2008-2010, SME_A made a profit as an average of USD 670,000 a year.

Overview of SME_B: The business focuses on wireless services and internet network. It started in 2001 by a duo who were friends and just graduated in the field of engineering. At the beginning, the business focused on developing an application on mobile phone. Later on, the business model was modified. Instead of selling the applications to end-users, it made contracts with mobile phone producers and distributors. This change has provided the SME_B not just an increase in revenue but also an access to new knowledge when working with large companies. In 2007 SME_B became a business alliance with one of the biggest phone service providers in Thailand. Since then, the business model of SME_B has been changed to be the sole application developer for its business alliance.

SME_B mainly emphasizes service innovation for mobile phone users. However, the technological change in social network like Facebook and Twitter has brought difficulty to some parts of its services.

In addition, to generate more source of revenue SME_B also provides a service of system development for companies. This type of job also helps increase skills of the staffs. Considering its financial performance in the previous years, SME_B made an average profit of USD 1,300,000 per year.

Overview of SME_C: The business focuses on software. It started in 2001 by only two persons as founders, developing a computer controlling software program for internet cafe. The developed software could enhance internet service efficiency as it could control more numbers of computers. SME_C adopts a strategy of keeping up good quality of developed systems and pricing on unit base. Along the last three years SME_C made an average profit per year of USD 2,700,000. Currently, SME_C has expanded its business to oversea markets in Singapore, Malaysia, Indonesia, and China. In addition, it extends its product line to mobile application as well as embedded electronic system development.

Overview of SME_D: The core service of this business is developing products of intelligent home electronic equipment. It emphasizes continuous R&D. All the products are high quality, user-friendly, and inexpensive when compared with the imported items. SME_D adopts a branding strategy. All the products are available only in large department stores and electronics specialty stores. The company also participates in business events such as product expo and publicizes in magazines. Along the last three years SME_D made a yearly profit as an average of USD 667,000.

Knowledge Management for Innovation Management Process of Thai SMEs

To explore the conducts of Thai SMEs related to grassroots technological innovation development, the four selected Thai SMEs were intensively investigated using the concept of the relationship between knowledge management and grassroots innovation management. The process is as shown in Figure 2.

Based on the four successful Thai SMEs case analysis following the concept shown in Figure 2, it was found that each SME shared some common concepts and conducts in managing knowledge for grassroots innovation management. Importantly, all of the four entrepreneurs are knowledgeable in a technical work aspect. They are determined and work hard. The common problem they all encountered at the beginning was related to management and marketing issues.

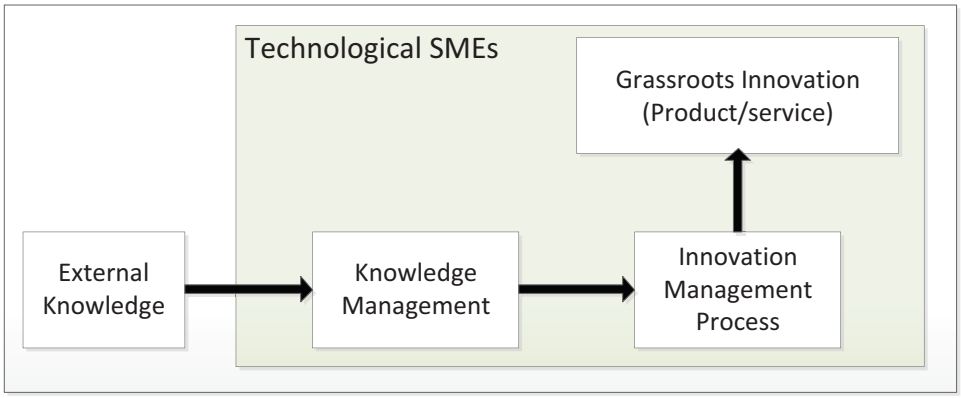


Figure 2 Concept of knowledge management for Thai SMEs' innovation management process

Knowledge Management Practices and Innovation Management Process

Innovation management process consists of 1) idea generation, 2) idea selection and evaluation for innovation, 3) design and innovation development, and 4) launching an innovation to markets. Accordingly, table 1 below summarizes the findings of knowledge management practices within the innovation management process from idea generation to launching an innovation to the market of the four successful Thai SMEs: SME_A, SME_B, SME_C, and SME_D. However, the innovation management process is not straightforward but evolves in numerous loops within the different process phases.

Table 1 Thai SMEs practices on innovation management process and KM practices

Innovation management process	Knowledge management practices (KM Practices)	SMEs			
		A	B	C	D
1. Idea generation	• An idea is initiated by the entrepreneurs/business owners	✓	✓	✓	✓
	• Integrate ideas with its business alliances		✓		
	• Learn from world-class organizations about their innovative products/services	✓	✓	✓	✓
	• An idea is created from customers' direct comments and comments on social network	✓	✓		✓
	• Create a fine work environment		✓		✓
2. Idea selection for innovation	• Decisions were made by the entrepreneurs/business owners based on their experiences	✓		✓	✓
	• Decisions were made together with its alliances based on the opportunity of success analysis		✓		
3. Design and innovation development	• Design and develop innovation based on their experiences and knowledge gained from extending their existing products	✓	✓	✓	✓
	• Design and develop innovation based on R&D team	✓	✓	✓	✓
	• Enhance competence of staff through coaching and on-the-job training	✓	✓	✓	✓
	• Store data and information regarding the process, problems, and approach to product development for each product category	✓	✓	✓	
4. Launching an innovation to markets	• Building trust to public by having the product tested by recognized institutions to obtain a quality certificate				✓
	• Launch the products directly to the market	✓		✓	✓
	• Launch the products to markets through their business alliances		✓	✓	✓

Idea Generation: For SMEs, idea generation for creating an innovation is usually viewed as to create something new to markets or to improve the quality of the existing products or services so that their customers' needs are satisfied. Indeed, it should be in good quality with

an affordable price. Most of the time, the idea is created by the entrepreneur. Accordingly, the entrepreneurs or SME owners should be creative, eager to learn, and observant by characteristic.

Based on the case of SME_A, its entrepreneur is keen to create service innovation to promote and attract more users to utilize the service of the knowledge center. Mostly the idea is created from 3 sources: the entrepreneurs, comments from web board, and adapting the service innovation of the world-class service providers to make it fit with the Thai context. *"I need to learn continuously the technology trends, how it is going to change. I need to know what the-number-one business leader in this field is doing, what my customers want, what I should do. Moreover, I have to encourage my team to do the same thing I do, learning new things so that they can help me think and create a new idea"*, said the owners of SME_A.

Regarding the conduct of SME_B, it integrates the creation of products and services for its own and for the business operations of its alliances. Based on this fact, the concept of new product/service development is taken from both SME_B entrepreneur through the brainstorming with his team and its alliances. Realizing that the technological changes usually affect its alliances, the SME_B entrepreneurs emphasizes the fast learning so that the business can provide a quick response to the needs of its alliances' customers. This finally becomes a business opportunity for SME_B.

For SME_C, it emphasizes development of product innovation for its targets which are large organizations with a mixed variety of business types. Accordingly, modifying product innovation to match with each of its customers is essential. The SME_C entrepreneur stated *"if we know the customers' problems and needs, we then know how to customize our products' features to satisfy those needs. However, we still need to continue thinking creatively what needs to be done further so that our product quality can be improved and respond well to the needs of other groups of customers too."*

Considering SME_D, as it focuses on developing products for intelligent home, the SME_D entrepreneur takes the space in the office as a place to display the products. Office is arranged as a resort-style office, creating a relaxed environment. He believes that such a physical setting like this helps promote creativity. He said *"Actually, the office space here used to be a restaurant. It was reorganized and re-arranged, adding a green area and now it becomes a fine green office with trees and a pool, creating a relaxed working environment which helps create many good ideas."* The new ideas for product innovation of SME_D come from many sources. One is from the existing products itself. Somehow, it could be by accident. Some are from customers' problems and needs. They want the product to be more user-friendly. No matter what, the entrepreneur needs to be observant and skillful in analyzing a business opportunity.

It is obviously seen that all four cases of Thai SMEs mentioned above share one thing in common: an idea to create an innovation that works for business is usually integrated from many sources especially the knowledge about the product or service, comments from customers and business alliances as well as competitors. The mix of information from variety of sources is also useful for the further step of product design.

Acquiring an information and knowledge related to a qualification of the products or services from the target groups such as customers, distributors, business alliances as well as large-scale competitors is necessary. It should be done continuously so that the product or service improvement can be efficiently managed. Information technology, i.e. web-board, Facebook Fanpage, etc. are useful tools to acquire such an information especially the one direct from customers. Nevertheless, the entrepreneurs need to further analyze and synthesize the data utilizing their own experiences to make decision how to create an innovation.

Idea Selection for Innovation: With a variety of ideas to develop an innovation as well as some existing constraints for SMEs, an entrepreneur has to employ a process of idea selection to assure the quality of the decision to further develop an innovation.

The main criteria the SME entrepreneurs use to make a decision on new product or service development include the followings.

1) A technical feasibility which is a self assessment on its own existing capability and knowledge as well as what needs to be acquired to develop an innovation.
2) Time
3) Cost of operations
4) Value of investment
5) Level of risk
6) Business opportunity to make benefits

In the past, an entrepreneur who was a business owner exclusively made an assessment and a decision on the concept for an innovation development based on his or her own experience. Anyhow, making a decision solely caused an entrepreneur a lot of problems as they made a wrong decision. To avoid problems, an entrepreneur shares ideas and comments among business partners and alliances. During the process of idea sharing, there might be an offer of a support on new product development. SME_B has its business alliances engage in the brainstorming and decision making process. It gains a support from its alliances in terms of information as well as resources to develop product and service innovation.

Based on the observations of the researcher, it was found that these four SMEs encouraged all of their staffs to comment on their new products or services even though some of the staffs did not engage at all to the product or service development process. This is a way to acquire a different point of view. However, the decision to continue the product development or to commercialize the product still depends mainly on the entrepreneurs or business owners except for the one with the business partners as alliances.

Design and innovation development: At this stage, most of SME entrepreneurs focus on self designing and developing as for the reason of business confidentiality. This is true for those four SMEs under this research. However, each of them has different approach of innovation design and development.

SME_A: The approach taken by SME_A is the participation of all staffs since the beginning of the project. This is due to the limited number of employees. The entrepreneur aims to have all staffs clearly understand everything in the organization. However, once the project is well formed, a designated staff will be in charge later on.

To solve some hard problems occurring during the design process, the SME_A entrepreneur coordinates with academic institutions to get an advice. He said *"If we encounter a problem with no solution, we lean on professors in universities and they all are willing to help. It does not matter if we are alumni or not. Advice is available in those academic institutions. SMEs should turn on to this source of information."*

SME_B: The approach taken by SME_B is a team approach. Each team is assigned a particular task. With this approach, each team member can learn the job in-depth and has a clear cut of his or her responsibility. However, later on each team member will be re-assigned the new task so that they can learn more about others and be able to substitute each other.

For the projects that work for its alliances, the staffs of the SME_B are assigned to work in cooperation with its alliances whilst the SME_B entrepreneur takes a role of coordinator and leader of design and development team.

SME_C: The entrepreneur of this SME takes a role of developer, responsible for the design and development of the core of the product. The design for the minor parts of the product is assigned to team members. Everyone works separately on a particular task and then all the outputs from each team member are integrated by the entrepreneur. This is to maintain its business confidentiality. The SME_C entrepreneur has to assure that there is no imitation of their software products.

SME_D: As the entrepreneur emphasizes a good quality and valuable price for customers, the product developers are assigned challenging tasks from the SME_D partner who is in charge of the marketing. However, the design and development of the innovation are being responsible by SME_D partner who takes charge of the development team leader.

The development team leader assign tasks and responsibility to each team member based on skills and expertise of each. The leader himself is mainly responsible for the design and technical aspect especially for the business confidential one. SME_D concentrates on the design that is hard to imitate by others especially by the Chinese. To do so, it employs a reverse engineering approach for the design and develops intelligent software to control the functions of the products.

Additionally, SME_D places an importance on supplying good quality parts with good price to the innovation development. The SME_D entrepreneur said "some parts of the product are applied from the parts available for other products in the market. These parts are in good quality and inexpensive. It is not necessary to make a custom-made order. This helps us reduce the developing cost.

For the process of design and development of innovation, it is important that employees must be competent. Their skills and expertise need to be developed or it is difficult to achieve the goal of innovation development. The learning styles and work patterns of each SME are different mainly due to the entrepreneurs, type of work and number of workload. However, these entrepreneurs employ some activities to develop its own staffs, which include "a senior-junior training system", on-the-job training and problems recording system.

All four SME entrepreneurs are confident in their staffs as they conduct a fine process of human resource selection. SME_C entrepreneur said "*the major concerns for SMEs are capital and operational capability. We do not welcome such problems so we recruit only a competent person who can work and stay with us. We promise him or her a career success. We provide him or her chances to be partnership with us. It is only if he or she wants it and is competent enough.*"

Launching an Innovation to Markets: This is a highly important step and simultaneously a difficult one for SMEs. An innovative product/service becomes worthless if it is not accepted by customers or markets. According to the survey with those four SMEs, it is found that all of them used to encounter the marketing problem. However, at present all these SMEs have business alliances which support the product launching to markets. SME_B entrepreneur stated that *"we used to do it all by ourselves. It was so difficult that we almost failed. We were good at producing but not selling. We made a product that could not sell. We did not know what we made did not respond to the needs of the customers. We did not know where and how to sell. Once we have business alliances, it helps. Our partners know the markets, understand customers, and can access to marketing channels. At present, we are not afraid of making no sales anymore.*" This is consistent with the statement by SME_C entrepreneur: *"We used to think that we well understood the oversea markets. But, the truth is not. Right now we have oversea alliances which help us a lot. For example, our Malaysian alliance could help us generate more profits, which is much higher than what we did by ourselves."*

Applying knowledge management in the innovation management process helps enhance efficiency especially in terms of product quality and satisfying market needs. Obviously seen from the four cases of successful Thai SMEs, they all conduct activities related to knowledge management in the innovation management process. Even though there is no precise announcement within their organization that they are promoting knowledge management, the impact of knowledge management practices on innovation management hinges on determined and continuous actions of the SME entrepreneurs.

Knowledge Management for Grassroots Innovation in SMEs

Knowledge management can be utilized as a tool to support the technological SMEs in the grassroots innovation management process with higher efficiency. Knowledge management model for innovation management can be summarized in Figure 3.

It is necessary for SMEs to be capable of creating knowledge from research and development and integrate the knowledge within the organization with external knowledge, i.e. market knowledge from alliances, customer knowledge, competition knowledge, etc., in order to create its own concept for innovation development. The findings are aligned with Zeng, Xie, and Tam (2010) concluding in their research that the vertical and horizontal cooperation with customers, suppliers, and other firms played a more distinct role in the innovation process of SMEs than horizontal cooperation with research institutions, universities or colleges, and government agencies. Storing knowledge to reduce time consumption and costs in extending innovation must be considered as well. Transferring and sharing knowledge among employees is another important matter which helps develop employees to be knowledgeable and competent in innovation development.

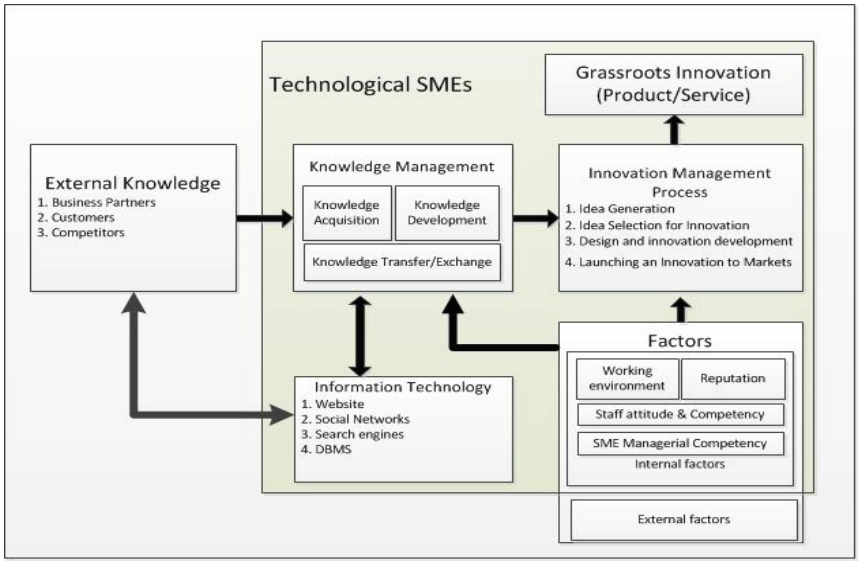


Figure 3 A Conceptual model of knowledge management for grassroots innovation in SMEs

As SME entrepreneurs or owners, they all are to be knowledgeable and have a vision in selecting the right concept for innovation development. Moreover, they should be able to plan and design the right innovation so that the products/service can respond well the market needs. Ability to efficiently manage organizational resources including human and physical resources is essential. Creating a good and casual working environment with the right attitude of employees helps elevate the efficiency of innovation development process.

In addition, it is an advantage for SME if the entrepreneurs are able to apply appropriate information technology to support knowledge management processes. For example, using information technology to acquire external knowledge, using database technology to store and retrieve knowledge for further innovation. Using website and Facebook to disseminate information and knowledge about product or service innovation to the target markets would also be recommended.

CONCLUSIONS

Nowadays knowledge management plays an important role in most organizations. It is one of the most important tools that can enhance competitive advantage. Comparing this tool to others, it costs less or even nothing as knowledge has already existed in an organization. Knowledge management becomes an efficient tool for organizations to successfully compete in the world of business.

Knowledge management supports an organization to achieve its goal. Well managing knowledge can create new knowledge essential for new product and service development as well as improve the innovation management process to be more efficient. As long as an organization gains efficiency and effectiveness, a chance of success is wide open.

Knowledge management can also be well applied for SMEs. Obviously seen from the cases presented above, it has proved that knowledge management is practiced by its nature, mostly

unofficially. The competence of SME staffs can be improved by implementing knowledge management more systematically, so does the innovation. It helps strengthen SMEs to be competitive and ready to play in the modern trading regions like ASEAN Economic Community (AEC) which are now approaching them.

ACKNOWLEDGEMENT

This paper is produced as a part of the project of "The Design of Knowledge Management to Enhance the Performance of the Grassroots Technological Innovation for SMEs in Thailand" supported by Kasetsart University Research and Development Institute (KURDI) at Kasetsart University.

REFERENCES

1. Martensson, M. 2000. A critical review of knowledge management as a management tool. Journal of Knowledge Management, 4(3):204-216.
2. McAdam, R. 2000. Knowledge Management as a Catalyst for Innovation within Organizations: A Qualitative Study. Knowledge and Process Management, 7(4): 233-241.
3. Numprasertchai, S., P. Kanjanasanpetch, and H. Numprasertchai. 2009. Knowledge creation and innovation capability in the public university. International Journal of Innovation and Learning, 6(5): 568-580.
4. Numprasertchai, S. and B. Igel. 2004. Managing knowledge in new product and service development: A new management approach for innovative research projects. International Journal of Technology Management, 28(7/8): 667-684.
5. OECD. 2010. The OECD innovation strategy: Getting a head start on tomorrow. Organization for Economic Co-operation and Development, Paris.
6. Office of Small and Medium Enterprise Promotion. White Paper on Small and Medium Enterprises of Thailand in 2011 Trends of 2012. pp.34-37.
7. Tuominen, M., P. Piippo, T. Ichimura, and Y. Matsumoto. 1999. An analysis of innovation management systems' characteristics. International Journal of Production Economics, 60-61: 135-143.
8. Zeng, S.X., Xie, X.M., and Tam, C.M. 2010. Relationship between cooperation networks and innovation performance. Technovation, 30: 181-194.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

PRODUCTISATION: A LITERATURE REVIEW

Janne Harkonen*, Department of Industrial Engineering and Management, University of Oulu, Finland, P.O. Box 4610, FI-90014 University of Oulu, Finland
E-mail: janne.harkonen@oulu.fi

Harri Haapasalo, Department of Industrial Engineering and Management, University of Oulu, Finland, P.O. Box 4610, FI-90014 University of Oulu, Finland
E-mail: harri.haapasalo@oulu.fi

Kai Hanninen, Department of Industrial Engineering and Management, University of Oulu, Finland, P.O. Box 4610, FI-90014 University of Oulu, Finland
E-mail: kai.hanninen@oulu.fi
***Corresponding author**

Professional biographies:

Dr Janne Harkonen received his Bachelor's degree (1st Class Honours) from University of Greenwich in the UK and both his M.Sc. in Process Engineering and Dr (Tech) in Industrial Engineering and Management, from the University of Oulu, Finland. He has also studied in the University of North Carolina at Wilmington, USA. He has worked for several years in the IT and environmental technology industries. Currently, he is a post doctoral research fellow at the University of Oulu in Finland. Dr Harkonen has authored and co-authored twenty-five journal articles, and also a number of other publications.

Dr Harri Haapasalo is Dean for Research, Faculty of Technology, and Professor of Technology Management in the Department of Industrial Engineering and Management at the University of Oulu. He has a Dr. Sc. in Technology Management and a Master's degree in Economics and Business Administration, both from the University of Oulu, Finland. He has research interests in planning, product management, product development and technology commercialisation.

Mr Kai Hanninen is a researcher at the Department of Industrial Engineering and Management at the University of Oulu, Finland. He has a Master's degree in Engineering. Mr Hanninen has over 10 years of experience in civil engineering and over 15 years experience in the telecommunication industry at the managerial level in R&D and technology management.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

PRODUCTISATION: A LITERATURE REVIEW

Janne Harkonen*, Department of Industrial Engineering and Management, University of Oulu, Finland, P.O. Box 4610, FI-90014 University of Oulu, Finland
E-mail: janne.harkonen@oulu.fi

Harri Haapasalo, Department of Industrial Engineering and Management, University of Oulu, Finland, P.O. Box 4610, FI-90014 University of Oulu, Finland
E-mail: harri.haapasalo@oulu.fi

Kai Hanninen, Department of Industrial Engineering and Management, University of Oulu, Finland, P.O. Box 4610, FI-90014 University of Oulu, Finland
E-mail: kai.hanninen@oulu.fi
***Corresponding author**

ABSTRACT

Purpose: *Productisation seems to be a managerial practice as the term is commonly used by practitioners. Industrial managers often comprehend productisation as combining and translating product, or service elements into a whole, that can be offered to customers. Dictionary defines productisation as "the act of modifying something to make it suitable as a commercial product". However, the literature is not clear with productisation. Therefore, the purpose of this study is to combine and analyse all journal articles referring to productisation. The aim is to obtain a better understanding on how the literature understands productisation, and how the discussion is distributed.*
Design/methodology/approach: *This study is founded on a thorough literature search, the approach being content analysis, with two main steps: 1) defining sources and procedures for the searches, and 2) defining categories for classifying the found articles (e.g. Li and Cavusgil, 1995). Keyword searches were conducted through article databases, including; Google Scholar, Scopus, Emerald and Science Direct. The analysed literature contains 185 journal articles.*
Findings: *The analysed articles are divided into five content categories. Productisation of products seems to be the most discussed theme, with 37.3 % of the articles classified into this category. Productisation of services, productisation of software, and productisation of technology are the next most covered with 25.4 %, 17.8 %, and 16.2 % of the articles respectively. Noteworthy is that most articles referring to productisation are relatively new. This study also clarifies the characteristics of productisation as recognised by the articles, together with identifying relevant research interfaces.*
Research limitations/implications: *The limitations of this study include analysing articles found in certain databases, potentially ignoring some important work. The implications include synthesising, and making available the overall state of research surrounding productisation.*
Originality/value: *The authors have not identified similar studies conducted on productisation.*

Keywords: Productisation; Productization; Product management; Product development; Literature review; Categorisation; Content analysis.

INTRODUCTION

Meeting the ever increasing customer demands and the resulting product proliferation are widely discussed in the literature (e.g. Forza and Salvador, 2002; Zhang et al., 2005; Bramham et al., 2005). Also, product development is widely discussed (e.g. Browning et al., 2002; Cooper and Kleinschmidt, 1995). Products are seen to constitute of tangible and intangible elements (Bitran and Pedrosa, 1998), to be a marketable mix of compatible hardware, firmware, and software (Mitola, 1999), or to be mainly software based, consisting of a set of computer programs, procedures, associated documentation, and data for delivery to users (Fricker, 2012). In addition, service industries are seen to have an increasingly important role in the global economy, while the basis of customer value is changing from manufacturing to a more product-service oriented systems (e.g. Wise and Baumgartner, 1999). Manufacturing companies increasingly provide product-service offerings rather than pure products; growth is often sought by increasing the sales of services (e.g. Baines et al., 2009). As a consequence, the scope of interaction with customers is being broadened from transactions to a relationship (Martinez et al., 2010).

Research on integration of products and services seems to use a variety of terminology, some discussing the same issues using different terms. Terminologies referring to the integration of products and services include system selling (e.g. Helander and Möller, 2006), bundling (e.g. Herrmann et al., 1997), system solution (e.g. Mont, 2002), integrated solutions (e.g. Davies et al., 2006), functional product (Alonso-Rasgado et al., 2004), functional sales (e.g. Sundin and Bras, 2005), product-service system (Morelli, 2002; Baxter et al., 2009), integrated product and service offering (Baines et al., 2007), and some others. The literature also uses terms of productisation and servitisation while discussing the integration of products and services (Geum et al., 2011). Nevertheless, the content and the level of discussion in the literature varies to a great degree, and is often very ambiguous, hence, this article focuses on clarifying one of the used terms, namely productisation.

This article presents a literature review on journal articles that refer to productisation to clarify the content of one part of the existing literature on the act of making something product-like, an offering that can be sold. An extensive literature search of academic journals was carried out through article databases, including; Google Scholar, Scopus, Emerald and Science Direct, yielding a total of 185 articles. Categories were defined and the found articles were classified.

This article attempts to answer the following research question:
RQ 1: How do the existing journal articles convey productisation?
RQ 2: What are the characteristics recognised for productisation and what are the relevant research interfaces?

Both research questions are answered based on literature findings.

METHODOLOGY

The research process applied in this study is described in Figure 1. This study is founded on a thorough literature search. According to Fink (2004) literature review is a systematic, explicit, and reproducible method for identifying, evaluating, and synthesising the existing body of recorded work. More particularly, the approach used in this study, is content analysis, a research technique for systematic, qualitative and quantitative description of the content of literature in an analysed area (Li and Cavusgil, 1995).

Figure 1 Research process

When carrying out a study on the state of knowledge in a field or subject, three principal basic approaches have been used (Li and Cavusgil, 1995). One of these three approaches is the Delphi method through which experts familiar with the studied area are surveyed (Dalkey and Helmer, 1963). The second one is meta-analysis, an approach in which empirical studies on a studied subject are collected and analysed statistically. For example, Montoya-Weiss and Calantone (1994) used this approach for analysing the determinants of new product performance. The third approach, the one utilised in this study, is content analysis, a research method used for systematic, qualitative and quantitative description of the content of literature in a field or subject.

The procedure for conducting content analysis is seen to contain two main steps: (1) defining sources and procedures for the search of articles, and (2) defining categories for the classification of the collected articles (Li and Cavusgil, 1995; Seuring et al., 2005; Marasco, 2008). These two steps have been applied in the review of literature referring to productisation. In this study, only journal articles are included in analysing the research surrounding productisation. Any books, business periodicals, conference proceedings and other written material are left outside the scope of the study. Literature for inclusion contained published journal articles but was not limited to any particular journals. Key word searches were conducted through article databases including Google Scholar, Scopus, Emerald and Science Direct. The keywords utilised in this study contain the both transatlantic forms of productisation. The utilised keywords were expected to appear in the articles. Should the keywords appear only in the list of references, not in the actual discussion, the article was not analysed further. Once articles were identified, their references were reviewed to aid in locating additional papers, resulting in some beneficial findings. Journal articles were carefully read to understand their content and analyse their contribution to the research questions and aims. As the terminology surrounding the topic of interest is not cemented, some additional keyword searches were also made to reveal the surrounding discussions. This procedure yielded a total of 185 journal articles that were identified by the databases and search engines combined. Even though a number of other potentially relevant publications, aside journal articles, may be found using the keywords, they were not included in this study. The reference list to this article contains all the found articles. Although there is always the possibility that some

articles have been missed, the reviewed journals constitute a reasonably representative body of productisation-related research work that has been published.

Classification categories

Based on the database searches and the analysis during this study, articles referring to productisation can be divided into five categories. These categories are: *Productisation of Products*: Those articles that convey productisation to be linked to offering that constitutes of tangible and intangible elements, often provided with supporting services. *Productisation of services*: Those studies that convey productisation to be linked to offering that constitutes of services that are often abstract and intangible. *Productisation of software*: Those articles that convey productisation to be linked to offering that is software based, consisting of computer programs, procedures, associated documentation, and data for delivery to users. *Productisation of technology*: Those articles that convey productisation to be linked to future offering that constitutes of technology currently under development. The biggest difference to the category of productisation of products, or other categories, is the discussion being more at frontiers of technological knowledge in terms of products and manufacturing technologies, and/or discussion closely related to technology topics. The category *other*: Contains those articles that include miscellaneous discussion, one that cannot objectively be linked to any of the other categories, yet the articles refer to productisation. The first four categories of articles referring to productisation each have their own characteristics and clear commonalities to a degree.

CLASSIFICATION AND REVIEW OF PRODUCTISATION LITERATURE

This chapter presents the classification of journal articles referring to productisation, based on a content analysis conducted during this study. Table 1 illustrates the distribution of the reviewed articles by the content categories. There are a total of five content categories, including; *productisation of products*; *productisation of services*; *productisation of software*; *productisation of technology*; and *other* context. The categories are based on the context of the discussion on productisation in the articles. Each article belongs to only one category.

It can be seen from Table 1 that the term productisation, in journal articles, is mostly linked to productisation of products with about 37 %, and to productisation of services with about 25 % of the total articles. Productisation is linked to productisation of software, third mostly with some 18 % of the articles. Roughly, 16 % of the total articles fall into the category productisation of technology. Finally, the category other, accounts for about 3 % of all the published journal articles.

Table 1 Distribution of articles by content (productisation)

Content category	Number of articles	Percentage of articles
Productisation of products	69	37.3
Productisation of services	47	25.4
Productisation of software	33	17.8
Productisation of technology	30	16.2
Other	6	3.2
Total	**185**	**100**

Table 2 shows the details of the classification by content, providing a summary of all the reviewed articles that fall under each category. Should anyone be interested in searching for references under the category topics, this table may prove beneficial.

Table 2 References by the content classification

Classification category	References
Productisation of products	Aksehirli (2000), Ayanoglu (1999), Belt et al., (2010), Beuren et al. (2013), Bowman and Swart, (2007); Cheng et al. (2009), Cummings and Haruyama (1999), Czuchry and Czuchry (2009), Danson et al. (2005), Eliezer et al. (2009), Eliezer and Staszewski (2011), Ferguson and Kline (1997), Fey (1985), Flamholtz (1995), Flamholtz and Aksehirli (2000), Flamholtz (2002), Flamholtz and Hua (2002), Flamholtz and Hua (2003), Flamholtz (2005), Flamholtz and Kurland (2005), Fujishiro (2011), Greco (2007), Hanninen et al. (2013b), Harkonen et al., (2009), Henton (2005), Hossain (2012), Huang et al. (2003), Iskanius et al. (2006), Karjalainen and Lappalainen (2011), Kasvi et al. (2003), Kettunen et al. (2009), Klein et al. (2010), Larsson et al., (2009), Leinonen et al. (2009), Leminen and Westerlund (2012), Leon et al. (2007), Lev. et al. (1995), Levänen and Hukkinen (2013), Ma and Fuh (2008), Maatta et al. (2009), Martin (1992), McDonald (1996), Meehan et al. (2010), Mitola (1999), Mort (2001), Murray (1999), Muzellec et al. (2012), Nakagawa et al. (2012), Nakazawa and Tokuda (2012), Nigussie et al. (2012), O'Mahoney et al. (2013), Parks and O'Hanlon (1993), Pratap and Arunkumar (2007), Pyron et al. (1998), Ruohonen et al (2006), Segarra (1999), Sharif (2012), Skervin (2010), Strand (2005), Tan (2003), Tanaka et al. (2012), Tatsumi (2011), Tikkanen and Jaakkola (2010), Tokumitsu (1999), Van der Loos (1995), Velamuri et al. (2011), Wiig (1997), Yamane et al. (2012), Yoshitake et at. (2011), Zhou et al. (2013)
Productisation of services	Aapaoja et al. (2012), Anupam et al. (2006), Artto et al. (2008), Aurich et al. (2009), Baines et al. (2007), Bask et al. (2010), Bask et al. (2011), Bruce et al. (2008), Chattopadhyay (2012), Crane (2005), Crane (2007), Daim et al. (2013), Geum et al. (2011a), Geum et al. (2011b), Gupta (2011), Hanninen et al. (2013a), Houlder and Williamson (2012), Jaakkola (2011), Kim (2009), Karmarkara and Apte (2007), Kim and Yoon (2012), Laperche and Picard, (2013), Leng et al. (2008), Maklan and Klaus (2011), Mattila et al. (2013), Meyer (1999), Morrison (2003), Nadim and Singh (2008), Nam et al. (2009), Nysten-Haarala et al. (2010), Ojala and Tyrväinen (2008), Park et al. (2012), Rajahonka (2013) Reitman (2001), Rekola and Haapio (2011), Rissanen et al. (2010), Salmi et al. (2008), Shin et al. (2009), Skalen and Hackley (2011), Stone (2010), Thomas (1994), Toivonen et al. (2008), Toivonen (2012), Ukko et al. (2011), Valminen and Wang et al. (2011), Vähätalo (2012), Wardlaw (2005)
Productisation of software	Alajoutsijärvi et al. (2000), Barzilay et al. (2009), Baumert et al. (1998), Carayannis (1998), Carayannis (1999), Davey et al. (1995), Emmerich and Sawyer (1998), Fay (2003), Feller et al. (2008), Helander and Kukko (2009), Helander and

Classification category	References
	Ulkuniemi (2006), Helander and Ulkuniemi (2012), Hori et al. (2004), Iivari and Molin-Juustila (2009), Kiessling et al. (1994), Kuivalainen et al. (2007), Marjakoski (2009), Mathur (2006), Mohapatra and Roy (2012),Mont et al. (2006), Nguyen and Sohn (2003), Ojala and Tyrväinen (2006), Parry et al. (2012), Russell (1994), Sainio and McBride et al. (2003), Salo and Kakola (2005), Seager and Gorda (2009), Takafuji (2011), Tsou et al. (2005), Vlaanderen et al. (2012), Wallin et al. (2002), Ward et al. (2006), Youngdahl et al. (2010)
Productisation of technology	Autio et al. (2004), Ballato and Stern (1999), Chew et al. (2006), Cross and Montemorra (2012), Elkind et al. (1999), Fontes (2005), Hantos (2011), Hou and Lin (2006), Hytönen et al. (2012), Karbhari (1995), Mathur (2007), Myers et al. (2002), Oh et al. (2009), Peterson (1995), Quey (2004), Sahlman and Haapasalo (2011), Saultz (1997), Shah et al. (2008), Shapira et al. (2012), Smith et al. (2002), Sohn et al. (2012), Sparkman (2002), Sturgill et al. (2008), Thompson and Azvine (2004), Van Den Elst et al. (2006), West (2008), Wisely (2007), Xiuli (2011), Zayadi (2012), Zhu et al. (2012)
Other	Dobris (2005), Lysgard, (2013), Parjanen (2012), Pekkola, (2013), Prokkola (2007), Wu and Guo (1999)

Based on the publication years, the articles that refer to productisation seem to be mostly relatively new. In the category *productisation of products*, the first article found was published in 1985, yet the majority of articles have been published after year 2000. Most articles in the category *productisation of services* have been published since year 2000. In the category *productisation of software*, the earliest found article had been published in 1994 and over half since 2000. Out of the articles classified to belong to the category of *productisation of technology*, some had been published in the 1990s, yet most were published after year 2000.

Figure 2 illustrates the origins of journal articles referring to productisation, as given in the affiliations for the first author.

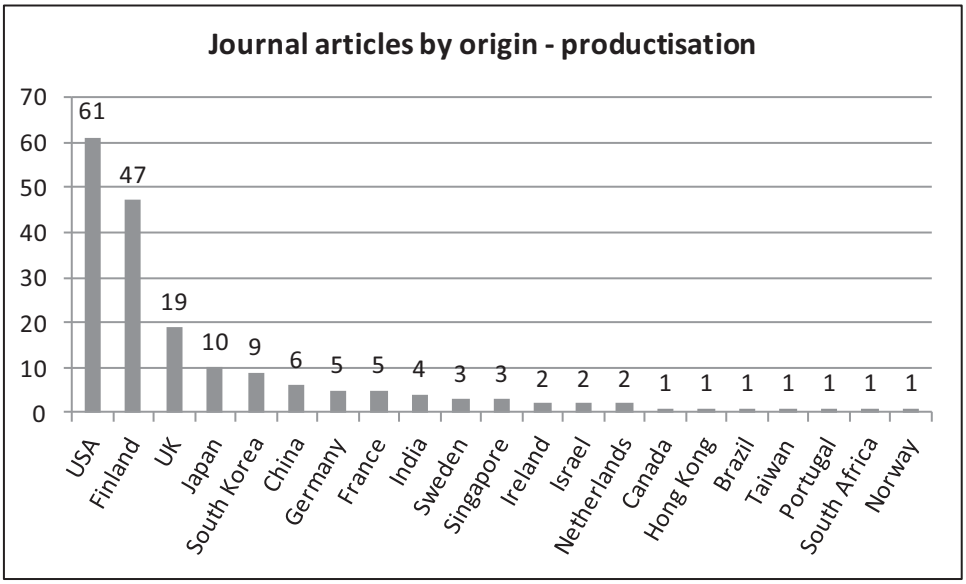


Figure 2 Journal articles by origin as given for the first author

The biggest proportion of journal articles that refer to productisation originate from the USA with 33.0 % of the articles, as given in the affiliations for the first author. Finland and UK are the next largest origins with 25.4 % and 10.3 % of the articles. Japan, South Korea, and China are the next biggest origins for journal articles referring to productisation with 5.4 %, 4.9 %, and 3.2 % of the articles, respectively. Should the European Union countries be seen as a single origin, the share of articles would be 84, or 45.4 % of the published journal articles.

Figure 3 presents the origins of the journal articles that refer to productisation, divided into the five classification categories. The origins of the articles are presented as given in the affiliations for the first author.

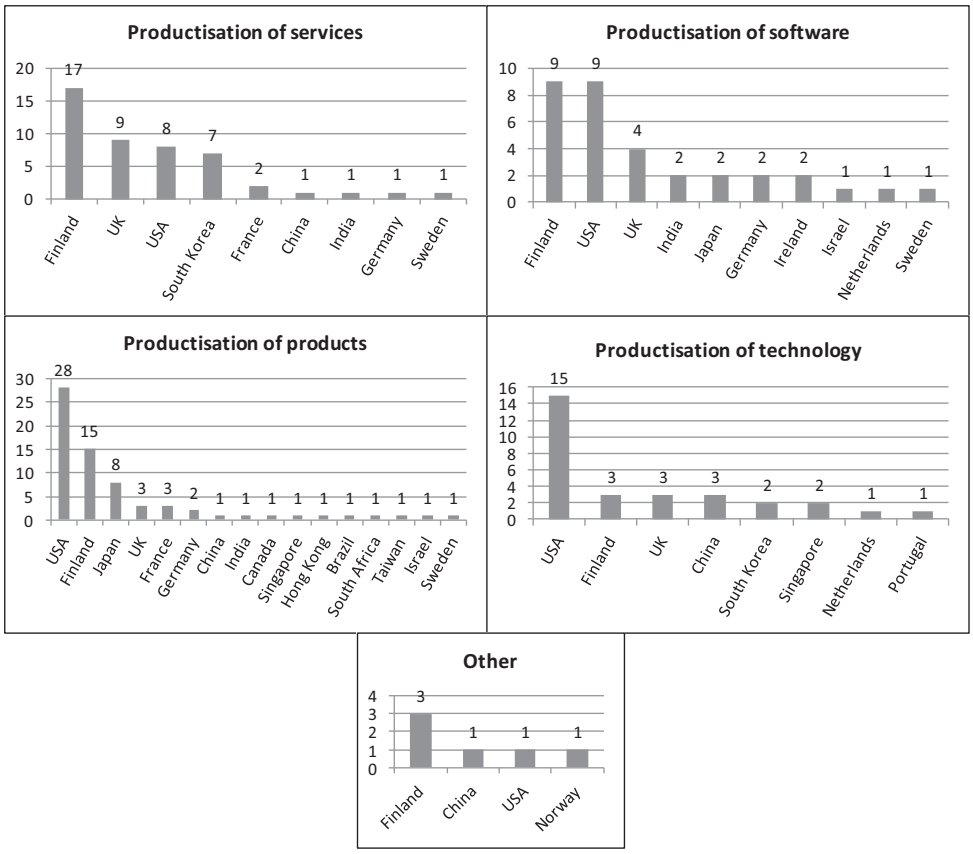


Figure 3 Journal articles by origin by the classification categories

The biggest proportion of journal articles that refer to productisation, in the category *productisation of services*, originate from Finland with 36.2 % of the articles. UK and USA are the next largest origins with 19.1 % and 17.0 % of the articles. South Korea is the origin for 14.9 % of the articles in this category. Should the EU countries be seen as a single origin, the share of articles would be 30, or 63.8 % of the articles in the category *productisation of services*. In the category, *productisation of software*, the biggest proportion of articles originate from Finland and USA with 27.3 % both. UK is the origin for 12.1 % of articles in this category. India, Japan, Germany, and Ireland are the next biggest origins with 6.1 % of articles each. If EU countries would be seen as a single origin, the share of articles for EU would be 19, or 57.6 % of the articles in the productisation of software category. The biggest proportion of journal articles that refer to productisation, in the category *productisation of*

products originate from USA with 40.6 %. Finland and Japan are the next biggest origins with 21.7 % and 11.6 % of the articles. UK and France come next with 4.3 % of the articles each. Germany is the origin for 2.9 % of articles in this category. Should the European Union countries be seen as a single origin, the share of articles would be 24, or 33.8 % of the published journal articles in the category *productisation of products*. In the category, *productisation of technology,* USA is the biggest origin of journal articles, with 50 % of the published articles. Finland, UK, and China are the next biggest ones with 10 % each. South Korea and Singapore are both the origin for 6.7 % of the articles. If EU countries were seen as a single origin, the share of published articles would be 8, or 26.7 % of the articles in the category of *productisation of technology*. The category *other* contains few miscellaneous articles that refer to productisation, ones that cannot be categorised into any of the other categories. Finland is the biggest origin in this category with 50 % of the published articles. The share for EU would be the same 3 articles, or 50 % of articles in the category *other*.

CONTENT ANALYSIS

The following chapters by the content categories present discussion supporting each category together with the content analysis of all the analysed articles. These chapters further reveal the type of discussion found in the articles of each category. Relevant research interfaces are also attempted to identify.

Productisation of products

Products often have tangible and intangible elements, tangible referring to physical elements and intangible to non-physical elements. The product development literature is seen to mostly deal with tangible characteristics of both elements (Bitran and Pedrosa, 1998). Products can range from fairly simple ones to complex systems, often provided with supporting services, sometimes also referred to product-service systems (e.g. Tukker, 2004). Typically, products are developed and produced to satisfy a need. However, understanding the needs of potential customers can be tricky, especially when considering intangible elements. For example, marketing literature often discusses value proposition and value creation in relation to understanding customer wishes. Customer wishes are seen to be met via processes of new product development and customer order fulfilment. (e.g. Slater, 1997). Value experienced by a customer is seen to be driven by product and process attributes, i.e. a process producing right deliverables and a product meeting the expectations (Browning, 2003). Marketing literature also discusses product differentiation in terms of attaining higher desirability and promoting sales (e.g. Sharp and Dawes, 2001). The literature also discusses commercialising products in conjunction with meeting customer expectations. Rapid commercialisation of new products is seen as one of the current top priorities in many organisations. (Harmancioglu et al., 2007). Producing a product recipe that satisfies requirements is emphasised as the goal of a product development process (Browning et al., 2002).

The literature referring to productisation of products mostly convey productisation as a phase in developing products (e.g. Eliezer et al., 2009; Karjalainen and Lappalainen, 2011; Meehan et al., 2010; Ayanoglu, 1999, Eliezer and Staszewski, 2011; Nigussie et al., 2012; Czuchry and Czuchry, 2009; Klein et al., 2010; Mort, 2001; Fujishiro et al., 2011; Nakazawa and Tokuda, 2012; Yamane et al., 2012; Tanaka et al., 2012; Yoshitake et

al. ,2011; Tokumitsu, 1999; Ferguson and Kline, 1997; Kettunen et al., 2009; Lev. et al., 1995; Iskanius et al., 2006; Strand, 2005; Zhou et al., 2013; Pratap and Arunkumar, 2007; Leminen and Westerlund, 2012; Tan, 2003; Leon et al., 2007; Fey, 1985; Huang et al., 2003; Martin, 1992; Parks and O'Hanlon, 1993, McDonald, 1996). Nevertheless, in many cases productisation is presented self-evidently as a part of the discussion, leaving room for interpretations. Some authors present productisation as an activity that follows a research and development (R&D) phase (e.g. Murray, 1999; Van der Loos, 1995). Ma and Fuh (2008) name and organise different development phases as: industrial design, conceptual design, detailed design, *productisation*, process planning, manufacturing, assembly, sales, maintenance, and recycle or destroy. Productisation is also presented as a late product development phase (e.g. Belt et al., 2010; Harkonen et al., 2009), and as a part of innovation cycle including R&D, new product development, productisation, after-sales, and disposal. (Maatta et al., 2009). Many articles present the development of products simply as productisation, including analysing the needs of customers, designing the product and developing the ability to produce it. They view productisation to involve, in the case of a production company, the design and manufacturing phases, and in the case of a service company, forming a system for providing services to customers. (Flamholtz and Hua, 2002; Flamholtz, 2002; Flamholtz, 2005; Flamholtz and Kurland, 2005; Flamholtz 1995; Flamholtz and Aksehirli, 2000). In many cases, R&D projects are seen to result in exploitation that includes productisation, i.e. making commercial products from R&D prototypes (Segarra, 1999). Productisation is also seen as an activity of making something tangibile in the real physical world (Muzellec et al., 2012). Tikkanen and Jaakkola (2010) view productisation to allow understanding product content to enable better quality. In addition, total time to market is suggested to include productisation efforts, while productisation simply means all activities required before a product is ready commercially (Pyron et al., 1998).

Other authors emphasise the marketability aspects in conjunction with productisation while viewing productisation as a phase in developing products. (Tatsumi, 2011; Cummings and Haruyama, 1999; O′Mahoney et al., 2013). Some authors discuss productisation purely as activities related to making something marketable (Leinonen et al., 2009; Henton, 2005; Cheng et al., 2009). For example, Mitola (1999) indicates a product being productised as a marketable mix of compatible hardware, firmware, and software modules. Skervin (2010) emphasise the value-adding aspects of productisation in developing products, while Greco (2007) view productisation as a part of value creation pipeline, a phase where validated concepts are converted into commercially ready products. Velamuri et al. (2011) associate productisation of products with hybrid value creation, i.e. the process of generating additional value by innovatively combining products (tangible component) and services (intangible component). Also, Bowman and Swart, (2007) associate productisation with value creation. Velamuri et al. (2011) also differentiate designing for hybrid value creation from traditional product offerings by hybrid value creation requiring the involvement of more stakeholders. Nakagawa et al. (2012) point out how, in collaborative product development, product requirements are often negotiated and how different actors may have their own interests during productisation. Productisation is also viewed to have two outputs, a product that is delivered to an internal or external customer, and knowledge related to the product, its production and use (Kasvi et al., 2003). Also, Wiig (1997) discusses the knowledge content.

The following aspects are also brought up by the journal articles referring to productisation of products. Sharif (2012) view productisation as an essential follow-up measure for commercialising R&D, linked to new goods and services, aside capitalising intellectual property (monetisation). Also, Hossain (2012) discusses productisation as a commercialisation activity. Van der Loos (1995) highlights the importance of involving the prototype developer and the importance of technical documentation for productisation. Levänen and Hukkinen (2013) see productisation as one of the critical points of industrial activities as the productisation process still contains significant risks. For example, productisation risks include products under productisation being potentially viewed differently in the eyes of the legislator. Hanninen et al. (2013b) present a concept of rapid productisation that covers versatile activities before the actual productisation.

Productisation of products is also associated with the concepts of complex product systems, customer solutions, extended products, functional products, hybrid products, hybrid solutions, integrated solutions, product based services, product related services, product services, product service systems, and servitisation. (e.g. Velamuri et al., 2011). Productisation is in some cases discussed as a part of product integration process, the product constituting of software, service components and a subset of application components. These parts are seen to be combined into more complex ones and eventually into a product or system that will be delivered to a customer. (Larsson et al., 2009). Productisation is also viewed as a process of defining products based on customer needs (Danson et al., 2005). Some authors view Product-Service System as the convergence of productisation and servitisation, trends that consider a product and a service as a single offering (e.g. Beuren et al., 2013). Ruohonen et al (2006) view productisation as standardisation - an opposite to cooperative customisation that is conducted when it is difficult for customer to express product preferences or the product involves complicated specifications.

As a summary on *productisation of products*, ignoring any terminology-related inconsistencies, the published journal articles recognise the following characteristics:

- seen as a process phase
- making something marketable
- activities before a product is ready commercially
- defining products based on customer needs
- hybrid value creation
- standardisation
- potentially three outputs, product, service and related knowledge
- a follow-up measure for R&D commercialisation
- making tangible

Productisation of Services

In the service industry, the object of exchange is abstract and intangible, a clear distinction between services and tangible products, (e.g. Shostack, 1977, Gummesson, 1991). Services are also characterised by heterogeneity, customer participation, and perishability (e.g. Chai et al., 2005). Services can be customised for individual customers' unique needs, and produced

and delivered as a result of an interactive process. However, in many cases services are only partially customised rather than bespoke solutions (e.g. Hipp, 2000; Aapaoja et al., 2012). High degree of customisation and the resulting heterogeneity are seen to cause challenges in communicating, promoting, and pricing service products (e.g. Clemes et al., 2000).

The literature referring to productisation of services points out how service productisation is acknowledged among practitioners, discussed commonly in managerial magazines and seminars, but not discussed explicitly in the academic literature. (e.g. Jaakkola 2011). Productisation of services is seen to be conducted due to various challenges, including inefficient production of services, services being tailored from scratch for each client, difficulties by customers and company employees perceiving the service offering (Valminen and Toivonen, 2012; Jaakkola 2011).

A need to make services more product-like, repeatable, and tangible are seen as the motivations for productisation of services, hence productisation contributing to competitiveness and overall efficiency (e.g. Valminen and Toivonen, 2012; Bask et al., 2010; Chattopadhyay, 2012; Karmarkara and Apte, 2007; Skalen and Hackley , 2011; Morrison, 2003; Nadim and Singh, 2008; Rissanen et al., 2010; Mattila et al., 2013; Ojala and Tyrväinen , 2008; Gupta, 2011). Productisation is also seen as a tool for packaging services (Ukko et al., 2011; Bruce et al., 2008).

Most of the literature on productising of services view productisation as means for enhancing customer understanding, an activity by which a company gives a service more tangible features, and makes buying easier (e.g. Salmi et al., 2008; Valminen and Toivonen, 2012). Hence, productisation is seen to help customers to understand where they get value and what they spend money on, potentially influencing a company's revenues positively (e.g. Stone, 2010; Chattopadhyay, 2012). Shin et al. (2009) view service productisation as a way to stabilise revenue stream through the resulting continuity. In addition, Artto et al., (2008) view pricing of services and service productisation to be closely related activities. Chattopadhyay (2012) emphasises how productisation makes pricing of the service easier. On the other hand, Rekola and Haapio (2011) emphasise the importance of justifying expenses on productisation activities for ensuring continuity.

In productisation of Services customers are seen to have a role in producing the services (e.g. Jaakkola 2011). Nysten-Haarala et al. (2010) highlight productisation as a pre-sale activity. Productisation is also seen beneficial for cooperation with clients (e.g.Toivonen et al. 2008), for example, Anupam et al. (2006) point out how productisation can be favourable in learning customer preferences. Also, Hanninen et al. (2013a) discuss the customer interface.

Productisation of services is also discussed in conjunction with standardisation (e.g. Meyer , 1999), and service productisation is seen to be particularly essential for implementing modular products (Vähätalo, 2012). Rajahonka (2013) views productisation as a characteristic of modularity in services. Productisation of services includes standardisation and modularisation of service processes (Kim, 2009). Productisation of services is also presented as a part of a value creation mechanism (Nam et al., 2009), and seen as a managerial practice (Jaakkola 2011). Productisation is also

seen as one of the stages of service content lifecycle (e.g. Crane, 2005; Crane, 2007; Daim et al., 2013; Wardlaw, 2005; Reitman, 2001). Geum et al. (2011a) view productisation as a relationship between technology and a service, one on which eventually evolves towards productisation, i.e. development of a product that combines technology and service.

In general, the discussion on productisation of services in the published journal articles seems to be somewhat limited and lacking depth. Also, the terminology utilised is not unambiguous. Neither are the discussed issues new, for example, already Levitt (1976) referred to standardisation of services when discussing industrialisation of services.

Productisation of services and *servitisation* of products are seen as overlapping concepts (e.g. Bask et al., 2011). The borderline between products and services is seen to be disappearing while products are servitised and services are productised (Thomas, 1994). Servitisation is seen as a concept related to productisation, yet the relationship between service and product elements are somewhat different in these two. According to Chattopadhyay (2012) productisation of services is accomplished largely by associating tangible features with intangible service offerings. Geum et al. (2011a; 2011b) view servitisation to mean converting an existing manufacturing offering to a service that includes elements such as planning, consultation, realisation and evaluation. McAloone and Andreasen (2002) present an example of servitisation on Xerox, changing its competitive offering from manufacturing copying machines to offering an integrated document management service. Park et al. (2012) see servitisation as companies offering fuller market packages, or bundles of customer-focused combinations of goods, services, support, self-service, and knowledge. In simple terms, servitisation could be understood as a shift from selling products to selling integrated product and service offerings that deliver value in use (e.g. Martinez et al., 2010). Companies are increasingly adopting a service oriented model on manufacturing (e.g. Wang et al., 2011). Delivering value in use is also discussed using the concept of *product-service system* (e.g. Baines et al., 2007), the difference to other concepts is in the existing approaches starting from the perspective of a physical product (Aurich et al., 2009). Also, Kim and Yoon (2012), Laperche and Picard, (2013), and Baines et al. (2007) see a strong link between productisation, servitisation and product-service systems.

As a summary on *productisation of services*, aside any terminology-related inconsistencies, the published journal articles recognise the following characteristics:

- making services more product-like
- defining services better
- systemising and creating repeatability
- making more tangible
- enhancing and improving services
- standardisation and modularisation of services
- making service production more efficient and profitable
- combining a tangible product and service offerings

Productisation of software

Many of today's products are increasingly software-based, rather than electro-mechanical. A software product is seen to consist of a set of computer programs, procedures, associated documentation, and data for delivery to users. (e.g. Fricker, 2012). Software products are seen flexible and soft, allowing relatively easy changes in a technical sense (Kilpi, 1997). A software product can also be seen as modular, consisting of one or more software modules (Ajila and Dumitrescu, 2007). Hence, a software product consists of many artefacts that are linked (Beuche et al., 2004).

The discussion on productisation of software in journal articles seems to be somewhat limited and lacking depth. Nevertheless, the literature does refer to productisation, even if the term is occasionally taken for granted. Productisation of software is seen to relate to characteristics and concerns that software systems should adopt as soon as they become products, i.e. deployment, security, configuration, and usability among any others (Barzilay et al., 2009).

Productisation of software is viewed as a managerial area related to marketing challenges, indicating that customer understanding of software products could be one of the driving forces (Helander and Ulkuniemi, 2006; Helander and Ulkuniemi, 2012; Baumert et al., 1998; Mohapatra and Roy, 2012). Productisation of software is also seen as means to demonstrate value (e.g. Feller et al., 2008), and make a product more tangible so that a buyer is able to test its functionality before the purchase decisions (Alajoutsijärvi et al., 2000). Productisation of software is also seen as means for standardisation and reproducibility. (Sainio and Marjakoski, 2009; McBride et al. 2003; Ward et al., 2006).

The discussion in Mont et al. (2006) indicates that productisation of software relates to packaging software to a form that can be offered to customers. Hence, productisation can be seen as an activity that relates to marketability (e.g. Kiessling et al., 1994; Emmerich and Sawyer, 1998). A process of converting routine software functions into modules that can act as building blocks for different applications (Youngdahl et al., 2010).

On the other hand, productisation is also seen as a process phase after creating an initial prototype, created to prove a concept (Davey et al.; 1995; Tsou et al., 2005; Seager and Gorda, 2009; Carayannis, 1999; Hori et al., 2004; Takafuji, 2011; Fay, 2003; Nguyen and Sohn, 2003; Mont et al., 2006). Wallin et al. (2002) present productisation as a phase of a software development life-cycle model, one that precedes production. Productisation is seen as a process involved in software effort (e.g. Russell, 1994), but not discussed thoroughly in journals.

From the perspective of software industry, productisation is seen to include a shift from unique service-intensive customer projects towards tangible standardised products aimed for international markets. (Alajoutsijärvi et al. , 2000; Helander and Kukko, 2009; Kuivalainen et al., 2007). In other words, productisation of software is seen as a transformation process from customer specific software to a standard product (Vlaanderen et al., 2012), meaning that productisation relates to delivering standardised software products (e.g. Parry et al., 2012; Salo and Kakola, 2005).

Ojala and Tyrväinen (2006) view the degree of a software productisation to be connected to the amount of required installation and after-sales services, where a low level of productisation means that a product requires intensive consulting, support, and maintenance, while a highly productised software product can be installed and used by customers without additional support. Nevertheless, according to Iivari and Molin-Juustila (2009), the extent to which users are listened during product based software product development is not dependent on the degree of productisation.

In addition, productisation of software is seen as an emerging trend, (Mathur, 2006), discussed in conjunction with final quality and packaging of a product, and also, incremental innovation is seen to be prevalent in productisation (Carayannis, 1998). Productisation is also seen as one of the central capabilities of software product business. (Alajoutsijärvi et al., 2000; Helander and Ulkuniemi, 2006).

Discussion, similar to productisation can be found in articles on *software product management* (e.g. Ebert, 2009; Fricker, 2012; Helferich et al., 2006). Software product management is seen as a discipline and a business process that governs a product from inception to the market to generate the largest possible value to a business (Ebert, 2009). Nevertheless, also the discussion on software product management is seen to lack in some aspects, as for example, Ebert (2007) calls for clarifying the roles of product manager, project manager, and marketing manager to successfully define, engineer, produce, and deliver a product.

As a summary on *productisation of software*, ignoring any terminology-related inconsistencies, the published journal articles recognise the following characteristics:

- improving customer understanding
- demonstrating value
- tangibilising
- standardising
- reproducibility
- relates to required amount of support
- packaging to a form suitable for customers
- seen as a process phase

Productisation of technology

The literature on productisation of technology contains discussion that is more at the frontiers of technological knowledge in terms of products and manufacturing technologies (Thompson and Azvine, 2004; Shah et al., 2008; Sparkman, 2002; Elkind et al. 1999; Cross and Montemorra, 2012; Sturgill et al., 2008; Chew et al., 2006; Saultz, 1997, Wisely, 2007). In many cases the literature refers to productisation, but does not discuss it thoroughly. Productisation is seen as converting research findings, or technology into marketable products or services (Fontes, 2005). Myers et al. (2002) link productisation to three stages of technology development; i.e. *proof of concept*, *limited application*, and *widespread application*, particularly to the second and third ones.

Productisation of new technology is also linked to product development and technological innovation, while the discussion seems to refer a bit further into the unknown than in the category for productisation of products. (e.g. Mathur, 2007; Karbhari, 1995; Smith et al., 2002). Productisation is also conveyed as a development phase, aside sufficient supporting infrastructures of scientific understanding of a technology, engineering design, process and product development, manufacturing, reliability, and such. (Myers et al., 2002). Hantos (2011) emphasises the technology readiness in relation to productisation of technology.

Few authors also imply commercialisation in conjunction with productisation of technology, productisation being a relevant activity (West, 2008; Autio et al., 2004; Xiuli, 2011). Productisation is also discussed together with technological innovation, and technology transfer (Oh et al., 2009; Autio et al., 2004; Van Den Elst et al., 2006; Peterson, 1995; Ballato and Stern, 1999). Oh et al. (2009) point out the importance of timely productisation when developing and planning to introduce disruptive technologies to the market. Sohn et al. (2012) discuss productisation in terms of technology evaluation; productisation is seen as a R&D variable among laboratories, patents, utility patents, and types of funding applications.

Another line of literature discusses productisation together with intellectual property, patenting and licensing technologies (Hytönen et al., 2012; Hou and Lin, 2006; Zayadi, 2012; Quey and Malhotra, 2004; Shapira et al., 2012). Hou and Lin (2006) discuss productisation in conjunction with patent/technology appraisal. Hytönen et al. (2012) point out how the royalty levels should be predictable enough to support the planning of technology development and productisation investments. Zayadi (2012) emphasises how one ought to consider whether they have adequate enough ideas for using, or productising a patent, and if not, consider licencing to someone who has the required depth to realise productisation of the technology. Quey and Malhotra (2004) mention productisation, referring to technology transformation; companies using their own intellectual property to others' platform technologies. Shapira et al. (2012) present productisation of technology as a part of a "double-boom phenomenon" where corporate patenting activity first concentrates on technological improvements, then followed by a period of technology productisation. The first cycle is seen to be propelled by technological prospects and the second by marketing prospects.

In addition to the above presented, Zhu et al. (2012) discuss productisation of technology and marketisation of products in terms of imitating technology, i.e. analysing existing technology and productising the core without infringing the relevant rights. Sahlman and Haapasalo (2011) refer to productisation relating to product offering relevant to technology management objectives, technology acquisition and development lead time for productisation in particular.

As a summary on *productisation of technology*, ignoring any terminology-related inconsistencies, the published journal articles recognise the following characteristics:

- at the frontiers of technological knowledge
- making something marketable
- a development phase
- relevant to product offering

Productisation – category other

Productisation, category *other*, contains all those journal articles that refer to productisation, but could not be objectively placed into any of the other categories. It was not possible to judge based on the discussion in these articles, whether they should be placed elsewhere. In some cases, it was clear that the article would not belong to any of the other categories. For example, Wu and Guo (1999) utilise the term productisation in the context of cybernetics and pansystems theory. Dobris (2005) discusses productisation of trusts and trustification. Prokkola (2007) uses the term productisation in the context of tourist destination packaging and commercialising a destination in a manner that the article could not be placed to the categories of products, or services. Neither could (Lysgard, 2013) be placed into any of the other categories, even if the article discusses productisation and culturalisation of products in conjunction with culture-based development strategies where experiences, services and products are seen to have a large role in peoples' lives. Parjanen (2012) uses the term productisation in the context of open innovation, innovation sessions, and exchange of ideas. In addition, Pekkola (2013) discusses productisation of academic work, i.e. work done by academics in universities or other higher education institutions. Some of the articles in this category have weak indications to packaging something and commercialising in reference to productisation activities. Other articles are merely impossible to judge.

CONCLUSIONS

The act of making something suitable as a commercial product is an important topic. Productisation is one of the relevant terms used when discussing these matters. Nevertheless, the previous literature is somewhat ambiguous when discussing productisation. This article aims to clarify the content of one part of the existing literature on the act of making something into a product-like offering. An extensive literature review is presented on journal articles that refer to productisation. A total of 185 relevant journal articles identified through article databases, including; Google Scholar, Scopus, Emerald and Science Direct, are analysed. Suitable categories are defined and the found articles are classified into these categories. The content of discussion on productisation is analysed carefully, together with identifying relevant research interfaces.

The literature that refers to productisation can be divided into five categories of *Productisation of*: *Products; Services; Software; Technology*; and *Other*. Respectively, the frequency of these categories is roughly 37 %, 25 %, 18 %, 16 %, and 3 % of the published journal articles. The four first categories have their own distinct characteristics. Articles in the category *Productisation of products* convey productisation to be linked to offering that constitutes of tangible and intangible elements, often provided with supporting services. Many of the articles in this category also view productisation as a process phase, or phase in new product development. Productisation of *services* conveys productisation to be linked to an offering that constitutes of services that are often abstract and intangible. The literature on productisation of *software* presents productisation to be linked to offering that is software based, consisting of computer programs, procedures, associated documentation, and data for delivery to users. Articles on productisation of *technology* convey productisation to be linked to future offering that constitutes of technology currently under development, more at the frontiers of technological knowledge.

The analysed journal articles are all relatively new; the majority of the articles have been published after year 2000, some during the 1990s, and even the earliest found article during the eighties. Hence, it seems that the streams of journal literature that refer to productisation are relatively new. Interestingly, large proportions, some 25 %, of all the articles originate from Finland, a small country of just over five million people. USA is the origin of one third of all the articles and the UK just over 10 %. The distribution of origins in different categories also varies somewhat. Although there is always the possibility that some articles have been missed, this review provides some reasonable insights into how the literature conveys productisation.

The literature on the first four identified categories of productisation of: *Products; Services; Software; and Technology* present some commonalities in terms of characteristics. Nevertheless, none of the identified characteristics are simultaneously common to all four categories, yet three characteristics could be identified that are common to three of the categories. Two of the characteristics are common for two categories. The literature on the categories of product, software, and technology indicate productisation as a process, or a development phase. The literature on categories product, service, and software see productisation as an activity that has a goal of standardisation, systematisation, better defining the offering, and reproducibility. The literature on product, service, and software also see productisation as an activity of making the offering more tangible, to translate something abstract into an exchangeable offer and make value more visible. In addition, product and technology categories present productisation as an activity of making something marketable, while only the articles in product and service categories refer to hybrid value creation through combining tangible and service offerings.

There seem to be many relevant research interfaces for productisation as productisation seems to have linkages to activities such as sales, new product development, product management and product data management. Linked or similar issues are also discussed in the literature in conjunction with the following concepts: product-service systems, product-service integration, servitisation, complex product systems, customer solutions, extended products, functional products, hybrid products, hybrid solutions, product service, software product management, marketising of products, commercialisation, and probably many others.

The implications of this study include any potential benefits of the review combining journal articles that refer to productisation and bringing together different streams of literature on an issue that is relevant to many companies. Clarifying the used terminologies, recognising the characteristics of productisation conveyed by the literature, and recognising relevant research interfaces may also be beneficial for those interested in the topic.

The limitations of this article includes the analysis only including those journal articles that refer to productisation, available, at the time of search, through the article databases of Google Scholar, Scopus, Emerald and Science Direct. Also, only journals were included in the review, as they are generally considered to be the highest level of research for acquiring information and disseminating new findings. Hence, this article

potentially ignores other relevant knowledge published in other forms of literature. Including knowledge from other sources might influence the results and the made conclusions. Also, the choice of terms utilised during the literature searches may have influenced the results.

Future analysis could include, a review of research approaches used in the literature referring to productisation, as well as the distribution of approaches by articles, and content categories. Future analysis could also include the level of journals that have published articles that refer to productisation. Aside addressing the limitations of this study, future studies could include, extending the literature search to cover potential other terminologies on the act of modifying something to make it suitable as a commercial product.

REFERENCES

1. Aapaoja, A., Kujala, J., and Pesonen, L.T.T. (2012), "Productization of University Services", *International Journal of Synergy and Research*, Vol. 1, No. 1, pp. 89-106.
2. Ajila, S.A., and Dumitrescu, R.T. (2007), "Experimental use of code delta, code churn, and rate of change to understand software product line evolution", *Journal of Systems and Software*, Vol. 80, No. 1, pp. 74–91.
3. Alajoutsijärvi, K., Mannermaaa, K., and Tikkanen, H. (2000), "Customer relationships and the small software firm: A framework for understanding challenges faced in marketing", *Information & Management*, Vol. 37, No. 3, pp. 153–159.
4. Alonso-Rasgado, T., Thompson, G., and Elfström, B.-O. (2004), "The design of functional (total care) products", *Journal of Engineering Design*, Vol. 15, No.6, pp. 515-540.
5. Anupam, V., Hull, R.B., Kanwal, S.S., and Kumar, B. (2006) "An introduction to lucent's service enhancement layer", *Bell Labs Technical Journal*, Vol. 10, No. 4, pp. 179–196.
6. Artto, K., Wikström, K., Hellström, M. and Kujala, J. (2008) "Impact of services on project business", *International Journal of Project Management*, Vol. 26, No. 5, pp. 497–508.
7. Aurich, J.C., Wolf, N., Siener, M., and Schweitzer, E. (2009), "Configuration of product-service systems", *Journal of Manufacturing Technology Management*, Vol. 20, No. 5, pp. 591-605.
8. Autio, E., Hameri, A.-P., and Vuola, O. (2004), "A framework of industrial knowledge spillovers in big-science centers", *Research Policy*, Vol. 33, No. 1, pp. 107-126.
9. Ayanoglu, E. (1999), "Wireless broadband and ATM systems", *Computer Networks*, Vol. 31, No. 4, pp. 395-409.
10. Baines, T.S., Lightfoot, H.W., Evans, S., Neely, A., Greenough, R., Peppard, J., Roy, R., Shehab, E., Braganza, A., Tiwari, A., Alcock, J.R., Angus, J.P., Bastl, M., Cousens, A., Irving, P., Johnson, M., Kingston, J., Lockett, H., Martinez, V., Michele, P., Tranfield, D., Walton, I.M., and Wilson, H. (2007) "State-of-the-art in product–service systems, Part B", *Journal of Engineering Manufacture*, Vol. 221, No. 10, pp. 1543–1552.

11. Baines, T.S., Lightfoot, H.W., Benedettini, O., and Kay, J.M. (2009), "The servitization of manufacturing: A review of literature and reflection on future challenges", *Journal of Manufacturing Technology Management*, Vol. 20, No. 5, pp. 547-567.
12. Ballato, A., and Stern, R. (1999), "Essay VI Innovative technology transfer initiatives", *Physical Acoustics*, Vol. 23, pp. 33-42.
13. Barzilay, O., Hazzan, O., and Yehudai, A. (2009) "A multidimensional software engineering course", *IEEE Transactions on Education*, Vol. 52, No. 3, pp. 413-424.
14. Bask, A.H., Tinnilä, M., and Rajahonka, M. (2010), "Matching service strategies, business models and modular business processes", *Business Process Management Journal*, Vol. 16, No. 1, pp. 153-180.
15. Bask, A., Lipponen, M., Rajahonka, M., and Tinnilä, M. (2011), "Framework for modularity and customization: service perspective", *Journal of Business & Industrial Marketing*, Vol. 26, No. 5, pp. 306-319.
16. Baumert, J., Critchfield, A., and Leavitt, K. (1998), "The need for a comprehensive expert system development methodology", *Telematics and Informatics*, Vol. 5, No. 3, pp. 325-334.
17. Baxter, D., Roy, R., Doultsinou, A., Gao, J., and Kalta, M. (2009), "A knowledge management framework to support product-service systems design", *International Journal of Computer Integrated Manufacturing*, Vol. 22, No. 12, pp. 1073-1088.
18. Belt, P., Harkonen, J., Mottonen, M., Kropsu-Vehkapera, H., and Haapasalo, H. (2010), "Technological uncertainty and verification & validation activities", *International Journal of Innovation and Learning*, Vol. 7, No. 2, pp. 223-243.
19. Beuche, D., Papajewski, H., and Schröder-Preikschat, W. (2004), "Variability management with feature models", *Science of Computer Programming*, Vol. 53, No. 3, pp. 333–352.
20. Beuren, F.H., Ferreira, M.G.G., and Miguel, P.A.C. (2013) "Product-service systems: a literature review on integrated products and services", *Journal of Cleaner Production*, In press, Accepted manuscript, available online.
21. Bitran, G., and Pedrosa, L. (1998), "A structured product development perspective for service operations", *European Management Journal*, Vol. 16, No. 2, pp. 169–189.
22. Bowman, C., and Swart, J. (2007), "Whose Human Capital? The Challenge of Value Capture When Capital is Embedded", *Journal of Management Studies*, Vol. 44, No. 4, pp. 488–505.
23. Bramham, J., MacCarthy, B., and Guinery, J. (2005), "Managing product variety in quotation processes", *Journal of Manufacturing Technology Management*, Vol. 16, No. 4, pp. 411-431.
24. Browning, T.R., Deyst, J.J., Eppinger, S.D., and Whitney, D.E. (2002), "Adding value in product development by creating information and reducing risk", *IEEE Transactions on Engineering Management*, Vol. 49, No. 4, pp. 443-458.
25. Browning, T.R. (2003), "On customer value and improvement in product development processes", *Systems Engineering*, Vol. 6, No. 1, pp. 49-61.
26. Bruce, G., Naughton, B., Trew, D., Parsons, M., and Robson, P. (2008), "Streamlining the telco production line", *Journal of Telecommunications Management*, Vol. 1, No. 1, pp. 15-32.

27. Carayannis, E.G. (1998), "Higher order technological learning as determinant of market success in the multimedia arena; a success story, a failure, and a question mark: AGFA/BAYER AG, Enable Software, and Sun Microsystems", *Technovation*, Vol. 18, No. 10, pp. 658–660.
28. Carayannis, E.G. (1999) "Knowledge transfer through technological hyperlearning in five industries", *Technovation*, 19, No. 3, pp. 141-161.
29. Chai, K.-H., Zhang, J., and Tan, K.-C. (2005), "A TRIZ-Based Method for New Service Design", *Journal of Service Research*, Vol. 8, No. 1, pp. 48-66.
30. Cheng, Y.S., Lam, K.W., Ng, K.M., Ko, R.K.M., and Wibowo, C. (2009), "An integrative approach to product development—A skin-care cream", *Computers & Chemical Engineering*, Vol. 33, No. 5, pp. 1097-1113.
31. Chattopadhyay, N. (2012), "Productisation of Service: A Case Study", *International Journal of Advanced Computer Science and Applications*, Vol. 3, No. 12, pp. 197-201.
32. Chew, K.W., Yeo, K.S., Chu, S.-F.S., and Cheng, M. (2006), "Impact of device scaling on the 1/f noise performance of deep submicrometer thin gate oxide CMOS devices", *Solid-State Electronics*, Vol. 50, No. 7–8, pp. 1219-1226.
33. Clemes, M., Mollenkopf, D., and Burn, D. (2000), "An investigation of marketing problems across service typologies", *Journal of Services Marketing*, Vol. 14, No. 7, pp. 573-594.
34. Cooper, R.G. and Kleinschmidt, E.J. (1995), "Benchmarking the Firm's Critical Success Factors in New Product Development", *Journal of Product Innovation Management*, Vol. 12, No. 5, pp. 374–391.
35. Crane, P. (2007), "A new service infrastructure architecture", *BT Technology Journal*, Vol. 25, No. 3-4, pp. 185-197.
36. Crane, P. (2005), "A new service infrastructure architecture", *BT Technology Journal*, Vol. 23, No. 1, pp. 15-27.
37. Cross, R.W., and Montemorra, M. (2012), "Drive-based recording analyses at >800 Gfc/in2 using shingled recording", *Journal of Magnetism and Magnetic Materials*, Vol. 324, No. 3, pp. 330–335.
38. Cummings, M., and Haruyama, S. (1999), "FPGA in the Software Radio", *IEEE Communications*, Vol. 37, No. 2, pp. 108-112.
39. Czuchry A.J.Jr., and Czuchry, A.J.Sr. (2009), "A tactician's approach to entrepreneurial ventures: phased-structuring as a model for commercialising innovations", *International Journal of Business Innovation and Research*, Vol. 3, No. 1, pp. 17-34.
40. Daim, T., Oliver, T., and Iskin, I. (2013), "Research and Development (R&D) Portfolio Management in the Electric Utility Sector: Does it change for the service sector?", *Benchmarking: An International Journal*, Vol. 20, No. 2, pp.186 - 211
41. Dalkey, N., and Helmer, O. (1963), "An Experimental Application of the DELPHI Method to the Use of Experts", *Management Science*, Vol. 9, No. 3, pp. 458-467.
42. Danson, M., Helinska-Hughes, E., Hughes, M., and Whittam, G. (2005), "National and local agency support for Scottish SME internationalisation activity: lessons for small transition economies", *International Journal of Entrepreneurship and Small Business*, Vol. 2, No. 4, pp. 312-330.
43. Davey, N., Barson, P., Field, S., Frank, R., and Tansley, D., (1995), "The development of a software clone detector", *International Journal of Applied Software Technology*, Vol. 1, No. 3/4, pp. 219-236.

44. Davies, A., Brady, T., and Hobday, M. (2006), "Charting a path towards integrated solutions", *MIT Sloan Management Review*, Vol. 47, No. 3, pp. 39-48.
45. Dobris, J.C. (2005), "The Death of the Rule Against Perpetuities, or the RAP Has No Friends - An Essay", *Real Property, Probate and Trust Journal*, Vol. 35, No. 49, pp. 601-665.
46. Ebert, C. (2007), "The Impacts of Software Product Management", *Journal of Systems and Software*, Vol. 80, No. 6, pp. 850-861.
47. Ebert, C. (2009) "Software Product Management", *CROSSTALK The Journal of Defense Software Engineering*, Vol. 22, No. 1, pp. 15-19.
48. Eliezer, O., and Staszewski, R.B. (2011), "Built-in measurements in low-cost digital-RF transceivers", *IEICE Transactions on Electronics*, Vol. E94.C, No.6, pp. 930-937.
49. Eliezer, O.E., Staszewski, R.B., Bashir, I., Bhatara, S., and Balsara, P.T. (2009), "A Phase Domain Approach for Mitigation of Self-Interference in Wireless Transceivers", *IEEE Journal of Solid-State Circuits*, Vol. 44, No. 5, pp. 1436-1453.
50. Elkind, J.L., Stimpson, D.I., Strong, A.A., Bartholomew, D.U., and Melendez, J.L. (1999) "Integrated analytical sensors: the use of the TISPR-1 as a biosensor", *Sensors and Actuators B: Chemical*, Vol. 54, No. 1–2, pp. 182-190.
51. Emmerich, W., and Sawyer, P. (1998), "Guest editorial", *Requirements Engineering*, Vol. 3, No. 2, pp. 71-72.
52. Fay, A. (2003), "A knowledge-based system to translate control system applications", *Engineering Applications of Artificial Intelligence*, Vol. 16, No. 5–6, pp. 567-577.
53. Feller, J., Finnegan, P., Fitzgerald, B., and Hayes, J. (2008), "From peer production to productization: A study of socially enabled business exchanges in open source service networks", *Information Systems Research*, Vol. 19, No. 4, pp. 475-493.
54. Ferguson, C.R.Jr., and Kline, M.D. (1997), "Adaptive welding for shipyards", *Industrial Robot: An International Journal*, Vol. 24, No. 5, pp. 349-358.
55. Fey, C.F. (1985), "Custom LSI/VLSI chip design productivity", *IEEE Journal of Solid-State Circuits*, Vol. 20, No. 2, pp. 555-561.
56. Fink, A. (2004), *Conducting Research Literature Reviews: From the Internet to Paper*, 2nd edition, Sage Publications, Thousand Oaks, California, USA.
57. Flamholtz, E. (1995), "Managing organizational transitions: Implications for corporate and human resource management", *European Management Journal*, Vol. 13, No. 1, pp. 39-51.
58. Flamholtz, E.G., and Aksehirli, Z. (2000), "Organizational success and failure: an empirical test of a holistic model", *European Management Journal*, Vol. 18, No. 5, pp. 488–498.
59. Flamholtz, E., and Hua, W. (2002), "Strategic Organizational Development and the Bottom Line: Further Empirical Evidence", *European Management Journal*, Vol. 20, No. 1, pp. 72–81.
60. Flamholtz, E.G. (2002), "Towards an integrative theory of organizational success and failure: previous research and future issues", *International Journal of Entrepreneurship Education*, Vol. 1, No. 3, pp. 297-320.
61. Flamholtz, E., and Hua, W. (2003), "Searching for Competitive Advantage in the Black Box", *European Management Journal*, Vol. 21, No. 2, pp. 222–236.

62. Flamholtz, E.G. (2005), "Strategic Organizational Development, Infrastructure, and Financial Performance: An Empirical Investigation", *International Journal of Entrepreneurship Education*, Vol. 3, No. 2, pp. 117-142.
63. Fontes, M. (2005), "The process of transformation of scientific and technological knowledge into economic value conducted by biotechnology spin-offs", *Technovation*, Vol. 25, No. 4, pp. 339-347.
64. Forza, C., and Salvador, F. (2002), "Managing for variety in the order acquisition and fulfilment process: The contribution of product configuration systems", *International Journal of Production Economics*, Vol. 76, No. 1, pp. 87–98.
65. Fricker, S.A. (2012), "Software Product Management", in Maedche, A., Botzenhardt, A. and Neer, L. (Ed.), *Management for Professionals*, Springer Berlin Heidelberg, Berlin, Heidelberg, pp. 53–81.
66. Fujishiro, Y., Suzuki, T., Yamaguchi, T., Hamamoto, K., and Awano, M. (2011), "Challenge for the development of micro SOFC manufacturing technology - compact SOFC using innovative ceramics integration process", *Synthesiology*, Vol. 4, No. 1, pp. 36-45.
67. Gebauer, H. (2008), "Identifying service strategies in product manufacturing companies by exploring environment–strategy configurations", *Industrial Marketing Management*, Vol. 37, No. 3, pp. 278–291.
68. Geum, Y., Lee, S., Kang D., and Park, Y. (2011a), "The customisation framework for roadmapping product-service integration", *Service Business*, Vol. 5, No. 3, pp. 213-236.
69. Geum, Y., Lee, S., Kang, D., and Park, Y. (2011b), "Technology roadmapping for technology-based product–service integration: A case study", *Journal of Engineering and Technology Management*, Vol. 28, No. 3, pp. 128–146.
70. Greco, J.F. (2007), "The commercialisation of bioinformatics and the threat of open-source software", *Journal of Commercial Biotechnology*, Vol. 13, No. 3, pp. 183–194.
71. Gummesson, E. (1991), "Truths and Myths in Service Quality", *International Journal of Service Industry Management*, Vol. 2, No. 3, pp. 7-16.
72. Gupta, V. (2011), "Corporate Response to Global Financial Crisis: A Knowledge-Based Model", *Global Economy Journal*, Vol. 11, No. 2, pp. 1524-5861.
73. Hanninen, K., Kinnunen, T., Haapasalo, H., Saarela, M., and Muhos, M. (2013a), "Use of Rapid Productisation in Welfare Service", *International Journal of Performance Measurement*, Accepted, in press.
74. Hanninen, K., Kinnunen, T., Haapasalo, H., and Muhos, M. (2013b), "Rapid productisation: challenges and preconditions", *International Journal of Product Lifecycle Management*, Accepted, in press.
75. Hantos, P. (2011), "Systems engineering perspectives on technology readiness assessments in software-intensive system development", *Journal of Aircraft*, Vol. 48, No. 3, pp. 738-748.
76. Harkonen, J., Belt, P., Mottonen, M., Kess, P., and Haapasalo, H. (2009), "Maturity of verification and validation in ICT companies", *International Journal of Innovation and Learning*, Vol. 6, No. 1, pp. 33-50.
77. Harmancioglu, N., McNally, R.C., Calantone, R.J., and Durmusoglu, S.S. (2007), "Your new product development (NPD) is only as good as your process: an exploratory analysis of new NPD process design and implementation", *R&D Management*, Vol. 37, No. 5, pp. 399–424.

78. Helander, N., and Ulkuniemi, P. (2006), "Marketing challenges in the software component business", *International Journal of Technology Marketing*, Vol. 1, No. 4, pp. 375-392.
79. Helander, N., and Ulkuniemi, P. (2012), "Customer perceived value in the software business", *The Journal of High Technology Management Research*, Vol. 23, No. 1, pp. 26–35.
80. Helander, N., and Kukko, M. (2009), "A Value-Creating Network Analysis from Software Business", *International Journal of Management and Marketing Research*, Vol. 2, No. 1, pp. 73-88.
81. Helferich, A., Schmid, K., and Herzwurm, G. (2006), "Product management for software product lines: an unsolved problem?", *Communications of the ACM*, Vol. 49, No. 12, pp. 66-67.
82. Henton, C. (2005), "Bitter Pills to Swallow. ASR and TTS have Drug Problems", *International Journal of Speech Technology*, Vol. 8, No. 3, pp. 247-257.
83. Herrmann, A., Huber, F., and Coulter, R.H. (1997), "Product and service bundling decisions and their effects on purchase intention", *Pricing Strategy and Practice*, Vol. 5, No. 3, pp. 99-107.
84. Hipp, C. (2000), "The incidence and effects of innovation in Services: evidence from Germany", *International Journal of Innovation Management*, Vol. 4, No. 4, pp. 417–453.
85. Hori, M., Ono, K., Abe, M., and Koyanagi, T. (2004), "Generating transformational annotation for web document adaptation: tool support and empirical evaluation", *Web Semantics: Science, Services and Agents on the World Wide Web*, Vol. 2, No. 1, 1, pp. 1-18.
86. Hossain, M. (2012), "Open Innovation Mill: Utilization of Nokia's Non-Core Ideas", *Social and Behavioral Sciences*, Vol. 58, pp. 765-773.
87. Hou, J.L. and Lin, H.Y. (2006), "A multiple regression model for patent appraisal", *Industrial Management & Data Systems*, Vol. 106, No. 9, pp. 1304-1332.
88. Houlder, D., and Williamson, P. (2012), "Professional Service Futures: the Professional Challenge", *Business Strategy Review*, Vol. 23, No. 4, pp. 50–55.
89. Huang, C.-J., Trappey, A.J.C., Yao, Y.-H., Yeh, S.-C., and Cheng, Y.-H. (2003), "Adopting Contact Center Approach To Collaborative Product Development-Using Tft-Lcd Design Chain As Case Study", *International Journal of Electronic Business Management*, Vol. 1, No. 3, pp. 120-128.
90. Hytönen, H., Jarimo, T., Salo, A., and Yli-Juuti, E. (2011), "Markets for standardized technologies: Patent licensing with principle of proportionality", *Technovation*, Vol. 32, No. 9–10, pp. 523–535.
91. Iivari, N., and Molin-Juustila, T. (2009), "Listening to the Voices of the Users' in Product Based Software Development", *International Journal of Technology and Human Interaction*, Vol. 5, No. 3, pp. 54-77.
92. Iskanius, P., Haapasalo, H., and Page, T. (2006), "Requirements for change in a traditional industry to be competitive: transformation towards an agile supply chain", *International Journal of Agile Systems and Management*, Vol. 1, No. 3, pp. 258-278.
93. Jaakkola, E. (2011), "Unraveling the practices of "productization" in professional service firms", *Scandinavian Journal of Management*, Vol. 27, No. 2, pp. 221-230.

94. Karbhari, V.M. (1995), "New product and process development methods as applied to polymer matrix composites: a perspective influenced by a JTEC study", *International Journal of Materials and Product Technology*, Vol. 10, No. 1-2, pp. 46-84.
95. Karjalainen, S., and Lappalainen, V. (2011), "Integrated control and user interfaces for a space", *Building and Environment*, Vol. 46, No. 4, pp. 938-944.
96. Kasvi, J.J.J., Vartiainen, M., and Hailikari, M. (2003), "Managing knowledge and knowledge competences in projects and project organisations", *International Journal of Project Management*, Vol. 21, No. 8, pp. 571–582.
97. Kettunen, P. (2009), "Adopting key lessons from agile manufacturing to agile software product development—A comparative study", *Technovation*, Vol. 29, No. 6–7, pp. 408–422.
98. Kiessling, W., Schmidt, H., Strata, W., and Dunzinger, G. (1994), "Declare and SDS: Early Efforts to Commercialize Deductive Database Technology", *VLDB Journal — The International Journal on Very Large Data Bases - Prototypes of deductive database systems archive*, Vol. 3, No. 2, pp. 211-243.
99. Kilpi, T. (1997), "Product Management Challenge to Software Change Process: Preliminary Results from Three SMEs Experiment", *Software Process-Improvement and Practice*, Vol. 3, No. 3, pp. 165–175.
100. Kim, H. (2009), "Service science for service innovation", Journal of Service Science, Vol. 1, No. 1, pp. 1-7.
101. Kim, S., and Yoon, B. (2012), "Developing a process of concept generation for new product-service systems: a QFD and TRIZ-based approach", Service Business, Vol. 6, No. 3, pp. 323-348.
102. Klein, R., de Haan, U., and Goldberg, A.I. (2010), "Corporate Exploration Competence and the Entrepreneurial Enterprise", Journal of the Knowledge Economy, Vol. 1, No. 2, pp. 86-116.
103. Kuivalainen, O., Lindqvist, J., Saarenketo, S., and Äijö, T. (2007), "International Growth of Finnish Software Firms: Starting Points, Pathways and Outcomes", Journal of Euromarketing, Vol. 16, No. 1-2, pp. 7-22.
104. Laperche, B., and Picard, F. (2013), "Environmental constraints, Product-Service Systems Development and Impacts on Innovation Management. Learning from Manufacturing Firms in the French Context", Journal of Cleaner Production, In press, Accepted proofs.
105. Larsson, S., Myllyperkiö, P., Ekdahl, F., and Crnkovic, I. (2009) "Software product integration: A case study-based synthesis of reference models", Information and Software Technology, Vol. 51, No. 6, pp. 1066-1080.
106. Leinonen, V., Heino, J., and Makkonen, H. (2009), "Towards eco-efficiency: granulated nickel slag's transformation into a product", Progress in Industrial Ecology, an International Journal, Vol. 6, No. 1, pp. 29-43.
107. Leminen, S. and Westerlund, M. (2012), "Towards innovation in Living Labs networks", International Journal of Product Development, Vol. 17, No. 1–2, pp. 43-59.
108. Leng, B., Weeks, D.P., and Mahapatra, M.K. (2008), "Automating network configuration tasks using multi-level modelling", Bell Labs Technical Journal, Vol. 12, No. 4, pp. 83–101.

109. Leon, A.S., Tam, K.W., Shin, J.L., Weisner, D., and Schumacher, F. (2007), "A Power-Efficient High-Throughput 32-Thread SPARC Processor", IEEE Journal of Solid-State Circuits, Vol. 42, No. 1, pp. 7-16.
110. Lev, L.A., Charnas, A., Tremblay, M., Dalal, A.R., Frederick, B.A., Srivatsa, C.R., Greenhill, D., Wendell, D.L., Pham, D.D., Anderson, E., Hingarh, H.I., Razzack, I., Kaku, J.M., Shin, K., Levitt, M.E., Allen, M., Ferolito, P.A., Bartolotti, R.I., Yu, R.K., Melanson, R.J., Shah, S.I., Nguyen, S., Mitra, S.S., Reddy, V., Ganesan, V., and De Lange, W.J. (1995), "A 64-b microprocessor with multimedia support", IEEE Journal of Solid-State Circuits, Vol. 30, No. 11, pp. 1227-1238.
111. Levitt, T. (1976), "The Industrialization of Service", Harvard Business Review, Vol. 54, No. 5, pp. 63–74.
112. Li, T., and Cavusgil, S.T. (1995), "A Classification and Assessment of Research Streams in International Marketing", International Business Review, Vol. 4, No. 3, pp. 251-277.
113. Lysgard, H.K. (2013), "The definition of culture in culture-based urban development strategies: antagonisms in the construction of a culture-based development discourse", International Journal of Cultural Policy, Vol. 19, No. 2, pp. 182-200.
114. Ma, Y., and Fuh, J.Y.H. (2008), "Product lifecycle modelling, analysis and management", Computers in Industry, Vol. 59, No. 2–3, pp. 107-109.
115. Maatta, J., Harkonen, J., Jokinen, T., Mottonen, M., Belt, P., Muhos, M., and Haapasalo, H. (2009), "Managing testing activities in telecommunications: A case study", Journal of Engineering and Technology Management, Vol. 26, No. 1-2, pp. 73-96.
116. Maklan, S., and Klaus, P. (2011), "Customer Experience: Are We Measuring the Right Things?", International Journal of Market Research, Vol. 53, No. 6, pp. 771-792.
117. Marasco, A. (2008), "Third-party logistics: A literature review", International Journal of Production Economics, Vol. 113, No. 1, pp. 127–147.
118. Martin, D.J.L. (1992), "Organisation of a large multi-national systems development", Annual Review in Automatic Programming, Vol. 16, No. 2, pp. 1–9.
119. Martinez, V., Bastl, M., Kingston, J., and Evans, S. (2010), "Challenges in transforming manufacturing organisations into product-service providers", Journal of Manufacturing Technology Management, Vol. 21, No. 4, pp. 449-469.
120. Mattila, O., Toppinen, A., Tervo, M., and Berghäll, S. (2013), "Non-industrial Private Forestry Service Markets in a Flux: Results from a Qualitative Analysis on Finland", Small-scale Forestry, Online First.
121. Mathur, G. (2007), "Problem-solving interdependence in technological innovation: an examination of interorganisational interaction in semiconductor component development", International Journal of Intelligent Enterprise, Vol. 1, No. 1, pp. 98-113.
122. Mathur, S.K. (2006), "Indian Information Technology Industry: Past, Present and Future & A Tool for National Development", Journal of Theoretical and Applied Information Technology, Vol. 2, No. 2, pp. 50-79.

123. McAloone, T.C., and Andreasen, M.M. (2002), “Defining product service systems”, in “Design for X” 10-11. October 2002 Proceedings of the13th symposium in University of Erlangen-Nürnberg, Neukirchen, Germany, pp. 51-60.
124. McBride, A.J., Del Olmo, M.L., Martin, B.T., and Finnegan, F.J. (2003), “Increased competitiveness through component technology for element management systems”, Bell Labs Technical Journal, Vol. 8, No. 3, pp. 31–49.
125. McDonald, J.A. (1996), “A full spectrum of epitaxial opportunities from the new Epitronics”, III-Vs Review, Vol. 9, No. 6, pp. 20-22.
126. Meehan, J., Busch, S., Noel, J., and Noraz, F. (2010), “Multimedia IP architecture trends in the mobile multimedia consumer device”, Signal Processing: Image Communication, Vol. 25, No. 5, pp. 317-324.
127. Meyer, M.H. (1999), “The strategic integration of markets and competencies”, International Journal of Technology Management, Vol. 17, No. 6, pp. 677-695.
128. Mitola III, J. (1999), “Technical Challenges in the Globalization of Software Radio”, IEEE Communications Magazine, Vol. 37, No. 2, pp. 84-89.
129. Mohapatra, S., and Roy, R. (2012), “Moving to products: entrepreneurial IT firms in India”, International Journal of Project Organisation and Management, Vol. 4, No. 1, pp. 86-97.
130. Mont, M.C., Pearson, S., and Thyne, R. (2006), “A Systematic Approach to Privacy Enforcement and Policy Compliance Checking in Enterprises”, Lecture Notes in Computer Science, Vol. 4083, pp. 91-102.
131. Mont, O.K. (2002), “Clarifying the concept of product–service system”, Journal of Cleaner Production, Vol. 10, No. 3, pp. 237–245.
132. Montoya-Weiss, M.M. and Calantone, R. (1994), "Determinants of new product performance: A review and meta-analysis", Journal of Product Innovation Management, Vol. 11, No. 5, pp. 397–417.
133. Morelli, N. (2002), “Designing Product/Service Systems: A Methodological Exploration”, Design Issues, Vol. 18, No. 3, pp. 3-17.
134. Morrison, A. (2003), “SME management and leadership development: market reorientation”, Journal of Management Development, Vol. 22, No. 9, pp. 796-808.
135. Mort, J. (2001), “Nature, value and pursuit of reliable corporate knowledge”, Journal of Knowledge Management, Vol. 5, No. 3, pp. 222-231.
136. Murray, T. (1999), “Authoring Intelligent Tutoring Systems: An Analysis of the State of the Art”, International Journal of Artificial Intelligence in Education, Vol. 10, pp. 98-129.
137. Muzellec, L., Lynn, T., and Lambkin, M. (2012), “Branding in fictional and virtual environments: Introducing a new conceptual domain and research agenda”, European Journal of Marketing, Vol. 46, no. 6, pp. 811-826.
138. Myers, D.R., Sumpter, C.W., Walsh, S.T., and Kirchhoff, B.A. (2002), “Guest editorial a practitioner's view: evolutionary stages of disruptive technologies”, IEEE Transactions on Engineering Management, Vol. 49, No. 4, pp. 322-329.

139. Nadim, A., and Singh, P. (2008), "Do all institutions benefit from leadership training? Challenging tradition through systems inquiry", Journal of Leadership Studies, Vol. 1, No. 4, pp. 74–83.
140. Nakagawa, H., Nagai, A., and Ito, T. (2012), "A Middle-Agent Framework Focused on the Role of Distributors", Journal of Information Processing, Vol. 20, No. 3, pp. 614-621.
141. Nakazawa, J., and Tokuda, H. (2012), "A three-tier architecture for user-centric ubiquitous networked sensing", ISRN Communications and Networking, Vol. 11, pp. 1-11.
142. Nam, K., Kim, Y.J., Yim, M.S., Lee, N.H., and Jo, A.R. (2009), "Understanding the Relationship between Value Co-Creation Mechanism and Firm's Performance based on the Service-Dominant Logic", Asia Pacific Journal of Information Systems, Vol. 19, No. 4, pp. 177-200.
143. Nigussie, E., Guang, L., Boyko, A., Hakkala, A., Sainio, P., Virtanen, S., and Isoaho, J. (2012), "Incubator Platform for Multidisciplinary Innovation in Research and Education", International Journal of Knowledge Society Research, Vol. 3, No. 3, pp. 1-16.
144. Nguyen, A.G., and Sohn, R.L. (2003), "Refactoring administrative services module platform software", Bell Labs Technical Journal, Vol. 8, No. 3, pp. 105–110.
145. Nysten-Haarala, S., Lee, N., and Lehto, J. (2010), "Flexibility in contract terms and contracting processes", International Journal of Managing Projects in Business, Vol. 3, No. 3, pp. 462-478.
146. Oh, Y., Suh, E.H., Hong, J., and Hwang, H. (2009), "A feasibility test model for new telecom service development using MCDM method: A case study of video telephone service in Korea", Expert Systems with Applications, Vol. 36, No. 3, pp. 6375–6388.
147. Ojala, A., and Tyrväinen, P. (2008), "Marketing software in Japan: Success factors in different product strategies", Romanian Marketing Review, Vol. 3, No. 4, pp. 53-79.
148. Ojala, A., and Tyrväinen, P. (2006), "Business models and market entry mode choice of small software firms", Journal of International Entrepreneurship, Vol. 4, No. 2-3, pp. 69-81.
149. O′Mahoney, J., Heusinkveld, S., and Wright, C. (2013), "Commodifying the Commodifiers: The Impact of Procurement on Management Knowledge", Journal of Management Studies, Vol. 50, No. 2, pp. 204-235
150. Parjanen, S. (2012), "Innovation sessions as sources of new ideas", International Journal of Innovation and Learning, Vol. 11, No. 4, pp. 352-368.
151. Park, Y., Geum, Y., and Lee, H. (2012), "Toward integration of products and services: Taxonomy and typology", Journal of Engineering and Technology Management, Vol. 29, No. 4, pp. 528–545.
152. Parks, H.G., and O'Hanlon, J.F. (1993), "The evolving role of defects and contamination in semiconductor manufacturing", Microelectronics Journal, Vol. 24, No. 4, pp. 313-327.

153. Parry, S., Jones, R., Rowley, J., and Kupiec-Teahan, B. (2012), "Marketing for survival: a comparative case study of SME software firms", Journal of Small Business and Enterprise Development, Vol. 19, No. 4, pp. 712-728.
154. Pekkola, E. (2013), "Academic Work Revised: From Dichotomies to a Typology", Workplace, No. 22, pp. 1-12.
155. Peterson, S. (1995), "Consortia partnerships: Linking industry and academia", Computers & Industrial Engineering, Vol. 29, No. 1–4, pp. 355-359.
156. Pratap, R., and Arunkumar, A. (2007), "Material selection for MEMS devices", Indian Journal of Pure & Applied Physics, Vol. 45, No. 4, pp. 358-367.
157. Prokkola, E.-K. (2007), "Cross-border Regionalization and Tourism Development at the Swedish-Finnish Border: Destination Arctic Circle", Scandinavian Journal of Hospitality and Tourism, Vol. 7, No. 2, pp. 120-138.
158. Pyron, C., Prado, J., and Golab, J. (1998), "Test strategy for the PowerPC 750 microprocessor", IEEE Design & Test of Computers, Vol. 15, No. 3, pp. 90-97.
159. Quey, T.M. (2004), "Technology transformation and purposed play: model development and implications for high tech product development", International Journal of Technology Management, Vol. 28, No. 1, pp. 62-87.
160. Rajahonka, M. (2013), "Views of logistics service providers on modularity in logistics services", International Journal of Logistics Research and Applications, Vol. 16, No. 1, pp. 34-50.
161. Reitman, G. (2001), "Streaming video with storage area networks", SMPTE journal, Vol. 110, No. 8, pp. 517-522.
162. Rekola, K., and Haapio, H. (2011), "Proactive contracting + Service design = Success!", International Journal of Services, Economics and Management, Vol. 3, no. 4, pp. 376-392.
163. Rissanen, S., Hujala, A., and Helisten, M. (2010), "The state and future of social service enterprises—a Finnish case", European Journal of Social Work, Vol. 13, No. 3, pp. 319-337.
164. Ruohonen, M., Riihimaa, J., and Makipaa, M. (2006), "Knowledge based mass customisation strategies: cases from Finnish metal and electronics industries", International Journal of Mass Customisation, Vol. 1, No. 2-3, pp. 340-359.
165. Russell, D.W. (1994), "Software engineering and production monitoring systems", Journal of Systems Integration, Vol. 4, no. 3, pp. 243-256.
166. Sahlman, K., and Haapasalo, H. (2011), "Objectives of strategic management of technology in a conceptual framework of enterprise practise", International Journal of Business Innovation and Research, Vol. 5, No. 2, pp. 142-158.
167. Sainio, L.M., and Marjakoski, E. (2009), "The logic of revenue logic? Strategic and operational levels of pricing in the context of software business", Technovation, Vol. 29, No. 5, pp. 368–378.
168. Salmi, P., Torkkeli, M., Ojanen, V., and Hilmola, O.-P. (2008), "New product creation process of KIBS firms: A case study", International Journal of Services and Standards, Vol. 4, No. 1, pp. 16-32.

169. Salo, A., and Kakola, T.K. (2005), "Groupware Support for Requirements Management in New Product Development", Journal of Organizational Computing and Electronic Commerce, Vol. 15, No. 4, pp. 253-284.
170. Saultz, J.E. (1997), "Rapid Prototyping of Application-Specific Signal Processors (RASSP) In-Progress Report", Journal of VLSI Signal Processing, Vol. 15, No. 1-2, pp. 29–47.
171. Seager, M., and Gorda, B. (2009), "A Collaboration and Commercialization Model for Exascale Software Research", International Journal of High Performance Computing Applications, Vol. 23, No. 4, pp. 395-397.
172. Segarra, G. (1999), "The advanced information technology innovation roadmap", Computers in Industry, Vol. 40, No. 2–3, pp. 185–195.
173. Seuring, S., Muller, M., Westhaus, M., and Morana, R. (2005), "Conducting a literature review—the example of sustainability in supply chains", in Kotzab, H., Seuring, S., Muller, M., Reiner, G. (Ed.), Research Methodologies in Supply Chain Management. Physica, Heidelberg, pp. 91–106.
174. Shah, M.K., Shin, W., Mouannes, J., Shaibani, A., Horowitz, S.W., and Carroll, T.J. (2008), "Method for rapid calculation of quantitative cerebral perfusion", Journal of Magnetic Resonance Imaging, Vol. 28, No. 5, pp. 1258–1265.
175. Shapira, P., Youtie, J., and Arora, S. (2012), "Early patterns of commercial activity in grapheme", Journal of Nanoparticle Research, Vol. 14, No. 4, article no. 811.
176. Sharif, M.N. (2012), "Technological innovation governance for winning the future", Technological Forecasting and Social Change, Vol. 79, No. 3, pp. 595-604.
177. Sharp, B., and Dawes, J. (2001), "What is Differentiation and How Does it Work?", Journal of Marketing Management, Vol. 17, No. 7-8, pp. 739-759.
178. Shin, J.H., Min, D., Wan, L., and Kim, J.H. (2009), "IT service 2.0: A case study of smart vending machines in Beijing", Journal of Service Science, Vol. 1, No. 2, pp. 227-243.
179. Shostack, L.G. (1977), "Breaking Free from Product Marketing", Journal of Marketing, Vol. 41, No. 2, pp. 73-80.
180. Skalen, P., and Hackley, C. (2011), "Marketing-as-practice", Scandinavian Journal of Management, Vol. 27, No. 2, pp. 189–195.
181. Skervin, H. (2010), "The Impact of International Students on Understanding and Conceptualizing of Equity", International Journal of Educational Policies, Vol. 4, No. 1, pp. 53-70.
182. Slater, S.F. (1997), "Developing a customer value-based theory of the firm", Journal of the Academy of Marketing Science, Vol. 25, No. 2, pp. 162-167.
183. Smith, L., Pham, T., Bower, J., Pilgrim, B., Schwarz, P., and Stevens, D. (2002), "Toward Voice Applications for Children", International Journal of Speech Technology, Vol. 5, No. 4, pp. 321-329.
184. Sohn, S.Y., Doo, M.K., and Ju, Y.H. (2012), "Pattern recognition for evaluator errors in a credit scoring model for technology-based SMEs", Journal of the Operational Research Society, Vol. 63, pp. 1051–1064.

185. Sparkman, D.O. (2002), "Mass Spectrometry PittCon®2002", Journal of the American Society for Mass Spectrometry, Vol. 13, No. 6, pp. 749-758.
186. Stone, M. (2010), "Smart utilities and CRM: The next phase of customer management in utilities", Journal of Database Marketing & Customer Strategy Management, Vol. 17, No. 1, pp. 49–58.
187. Sturgill, M., Golodetz, G., Simske, S., and Aronoff, J. (2008), "Security Printing Deterrents: A Comparison of Thermal Ink Jet, Dry Electrophotographic, and Liquid Electrophotographic Printing", Journal of Imaging Science and Technology, Vol. 52, No. 5, pp. 1-7.
188. Strand, D. (2005), "Ovonics: from science to products", Journal of Optoelectronics and Advanced Materials, Vol. 7, No. 4, pp. 1679-1690.
189. Sundin, E., and Bras, B. (2005), "Making functional sales environmentally and economically beneficial through product remanufacturing", Journal of Cleaner Production, Vol. 13, No. 9, pp. 913–925.
190. Takafuji, S., Kitamura, Y., and Mizoguch, R. (2011), "Evolution and commercial deployment of integrated technical knowledge management system based on ontology engineering", Transactions of the Japanese Society for Artificial Intelligence, Vol. 26, No. 5, pp. 547-558.
191. Tan, C.M. (2003), "Customer-focused build-in reliability: a case study", International Journal of Quality & Reliability Management, Vol. 20, No. 3, pp. 378-397
192. Tanaka, A., Shimada, H., Hiraiwa, N., and Arai, T. (2012), "Development of an Electronic Resin Throttle Body", SAE International Journal of Fuels and Lubricants, Vol. 5, No. 1, pp. 301-306.
193. Tatsumi, E. (2011), "Challenges in research and development, productization, and clinical application of advanced medical devices in Japan", Japan Medical Association Journal, Vol. 54, No. 5, pp. 331-334.
194. Tikkanen, I., and Jaakkola, L. (2010), "Evaluating the nutritional quality of menus by using software in professional kitchens", Nutrition & Food Science, Vol. 40, No. 4, pp. 378-387.
195. Thomas, M.J. (1994), "Marketing – in Chaos or Transition?", European Journal of Marketing, Vol. 28, No. 3, pp. 55-62.
196. Thompson, S.G. and Azvine, B. (2004), "No Pervasive Computing without Intelligent Systems", BT Technology Journal, Vol. 22, No. 3, pp. 39-49.
197. Toivonen, M., Brax, S, and Tuominen, T. (2008), "Client-oriented multicompetence: the core asset in KIBS", International Journal of Services Technology and Management, Vol. 10, No. 2-4, pp. 175-189.
198. Tokumitsu, T. (1999), "A World the 3DMMIC Develops", Journal of the Institute of Electronics, Information and Communication Engineers, Vol. 82, No. 8, pp. 865-867.
199. Tsou, D., Hantos, P., and Sie, C. (2005), "A case study of a centrally managed ERP implementation for manufacturing plants of a global corporation", International Journal of Internet and Enterprise Management, Vol. 3, No. 3, pp. 304-311.

200. Tukker, A. (2004), "Eight types of product–service system: eight ways to sustainability? Experiences from SusProNet", Business Strategy and the Environment, Vol. 13, No. 4, pp. 246–260.
201. Valminen, K., and Toivonen, M. (2012), "Seeking efficiency through productisation: A case study of small KIBS participating in a productisation project", Service Industries Journal, Vol. 32, No. 2, pp. 273-289.
202. Van Den Elst, J., Tol, R., and Smits, R. (2006), "Innovation in practice: Philips Applied Technologies", International Journal of Technology Management, Vol. 34, No. 3-4, pp. 217-231.
203. Van der Loos, H.F.M. (1995), "VA/Stanford rehabilitation robotics research and development program: lessons learned in the application of robotics technology to the field of rehabilitation", IEEE Transactions on Rehabilitation Engineering, Vol. 3, No. 1, pp. 46-55.
204. Velamuri, V.K., Neyer, A.-K. and Möslein, K.M. (2011), "Hybrid value creation: a systematic review of an evolving research area", Journal für Betriebswirtschaft, Vol. 61, No. 1, pp. 3-35.
205. Vlaanderen, K., Brinkkemper, S., and van de Weerd, I. (2012), "On the Design of a Knowledge Management System for Incremental Process Improvement for Software Product Management", International Journal of Information System Modeling and Design, Vol. 3, No. 4, pp. 1-21.
206. Vähätalo, M. (2012), "Modularity in Health and Social Services: A Systematic Review", International Journal of Public and Private Healthcare Management and Economics, Vol. 2, No. 1, pp. 1-15.
207. Wallin, C., Ekdahl, F., and Larsson, S. (2002), "Integrating business and software development models", IEEE Software, Vol. 19, No. 6, pp. 28-33.
208. Wang, P.P., Ming, X.G., Li, D., Kong, F.B., Wang, L., and Wu, Z.Y. (2011), "Status review and research strategies on product-service systems", International Journal of Production Research, Vol. 49, No. 22, pp. 6863-6883.
209. Ward, D.M., Strand, D.P., Senneke, W.A., Knolinski, B.L., Scheer, R.J., and McBride, A.J. (2006), "Domain management of IMS", Bell Labs Technical Journal, Vol. 10, No. 4, pp. 233–254.
210. Wardlaw, M.I. (2005), "Intelligence and mobility for BT's next generation networks", BT Technology Journal, Vol. 23, No. 1, pp. 28-47.
211. West, J. (2008), "Commercializing Open Science: Deep Space Communications as the Lead Market for Shannon Theory, 1960–73", Journal of Management Studies, Vol. 45, No. 8, pp. 1506–1532.
212. Wiig, K.M. (1997), "Knowledge management: Where did it come from and where will it go?", Expert Systems with Applications, Vol. 13, No. 1, pp. 1-14.
213. Wise, R., and Baumgartner, P. (1999), "Go downstream: the new profit imperative in manufacturing", Harvard Business Review, Vol. 77 No.5, 133–141.
214. Wisely, D. (2007), "Cellular mobile — the generation game", BT Technology Journal, Vol. 25, No. 2, pp. 27-41.

215. Wu, X., and Guo, D. (1999), "Pansystems cybernetics: Framework, methodology and development", Kybernetes, Vol. 28, No. 6, pp. 679-694.
216. Yamane, T., Maruyama, O., Nishida, M., and Kosaka, R. (2012), "Research and development of a monopivot centrifugal blood pump for clinical use-Collaboration between a medical team and an engineering team toward a product", Synthesiology, Vol. 5, No. 1, pp. 16-24.
217. Xiuli, L. (2011), "Probing the Guiding Role of Taxation in Energy-Saving and Emission-Reducing Technology", Energy Procedia, Vol. 5, pp. 20-24.
218. Yoshitake, Y., Tida, T., Mishima, A., Matsumoto, Y., and Shigyou, M. (2011), "Development of air flow equivalent circuits analysis combined with finite element method for high voltage air cooling inverter design (productization of parallel air flow inverter carrying different units)", Transactions of the Japan Society of Mechanical Engineers, Part B, Vol. 77, No. 774, pp. 292-300.
219. Youngdahl, W.E., Ramaswamy, K., and Dash, K.C. (2010), "Service offshoring: the evolution of offshore operations", International Journal of Operations & Production Management, Vol. 30, No. 8, pp. 798-820.
220. Zayadi, K.B. (2012), "Patent vault as a novel means to make businesses become recession–proof via facilitated diversification", International Journal of Intellectual Property Management, Vol. 5, No. 3-4, pp. 304-326.
221. Zhang, M., Chen, Y.J., and Tseng, M.M. (2005), "Distributed knowledge management for product and process variety in mass customisation", International Journal of Computer Applications in Technology, Vol. 23, No. 1, pp. 13-30.
222. Zhou, W.,Tang, Y., Wang, Q., Hui, K.S., Hui, K.N., Wan, Z., and Song, R. (2013), "Optimization of Catalyst Loading for Porous Copper Fiber Sintered Felts Used in Methanol Steam Reforming Microreactors", Chemical Engineering & Technology, Vol. 36, no. 2, pp. 307–314.
223. Zhu, Z.-M., Li, J.-S., and Chen, T. (2012), "Research on Evolution Mechanism of Technological Original Innovation—With Mutation Theory of Respective", Journal of Service Science and Management, Vol. 5, No. 1, pp. 28-36.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

WEBSITE ADOPTION: OVERVIEW OF MALAYSIAN COST ENGINEERING FIRMS

Ms. Zarina Syuhaida Shaarani, Student, MSc. (Quantity Surveying),School of Housing, Building and Planning, Universiti Sains Malaysia, Penang, Malaysia.
Corresponding: +60194575833
E-Mail: zarin.aida7373@gmail.com

Prof. Sr. Dr. Abdul Rashid Abdul Aziz, Lecturer, School of Housing, Building and Planning, Universiti Sains Malaysia.
E-Mail: arashid@usm.my

ABSTRACT

Purpose: *Website is a powerful tool in business today and its advantages have been well established in the research field of e-commerce, IT, ICT and SME. In construction-related professional sector, website could be a platform for greener, effective communication and collaboration among team members as well as a tool for marketing. However, the current scenario of website adoption in construction professional is unknown due to the lack of research. Therefore, this paper is intended to provide an overview of website adoption in Malaysian cost engineering firms in terms of adoption rate, the profiles of adopters and non-adopters, determinants and inhibitions of the adoption.*
Design/Methodology/Approach: *319 sets of questionnaire had been posted to all cost engineering firms throughout Malaysia, and then complemented by online survey. 58 firms out of 319 firms responded to the survey resulting in 18.1% response rate.*
Findings: *Website adoption rate in Malaysian cost engineering firms is 27.6%, 11.9% are developing own website and 69.0% plan to develop own website. Majority of the adopters are matured firms with more employees and higher average commission, compared to non-adopters. Meanwhile, adopters' projects predominantly from private and public sectors and mostly involved with overseas project. Furthermore, firm size, average commission and involvement with overseas project influenced the propensity to adopt this initiative. Finally, the slowness of adoption is associated with perceived 'not lead to more efficiency or lower cost', 'not lead to more commission' and 'lack of time'.*
Research Limitations/ Implications: *Low response rate jeopardised the credibility of the findings. However, it could be useful to indicate the current website adoption scenario in Malaysian cost engineering firms.*
Practical Implications: *Website could be utilised to help in firms' growth. The adoption could be a kick-start to grow and expand beyond local boundaries.*
Originality/ Value: *The scarcity of information regarding the adoption of website among construction-related professionals indicates that only few research have been done in this area.*

Keywords: Website adoption, cost engineering firm, profile, determinants, inhibitions
Classification: Research Paper

INTRODUCTION

Website could be more than just a shop window for a construction business and holds great entrepreneurial opportunities such as powerful branding and sustainable stakeholders' loyalty if designed and managed effectively (Preece et al., 2001). The advancement in web-based technologies enable website to be integrated with other software, hence expanding its purposes as communication and collaboration platform among project team members and reduce the impact of fragmentation in this industry. The scarcity of literature pertaining website adoption in construction related areas indicates that this area is not receiving sufficient attention from academicians in this field. Due to this constraint, most of the website adoption literatures have been derived from technology adoption such as IT, ICT and e-commerce among SMEs.

LITERATURE REVIEW

Benefits of Website

The precondition for success in today's business world is the use of internet technologies and aligned it with its organisational goals (Porter, 2001). Internet technologies have intrinsic characteristics that bring tremendous changes in conducting business; potentials to reduce costs of coordination, communication and information processing as well as able to reach a large number of potential clients (Tsikriktsis et al., 2004). Website is one of internet technologies and its adoption, especially in small businesses, takes the internet adoption to a higher level, regardless of the levels of website sophistication and its relevance to target customers (Simmons et al., 2008). Besides, adoption of e-business via website now is a low-price technology accessible to firms of any size, enabling smaller firms to be at par with their larger counterparts (Cerdan and Acosta, 2005).

Construction project is highly dependent on efficient communication, collaboration and successful competence integration (Gustavsson et al., 2012). The utilisation of web technologies promotes coordination and collaboration among team members of a project (Redmond et al., 2012). It enables faster and more effective information transfer, hence offer unique opportunities for teamwork and workflow automation across the organisations boundaries. Furthermore, the adoption could lead to better communication and financial control, increase the quality and timeliness of documentation, speed of works, simpler and faster access to common data and decrease in documentation errors. Apart from that, website could also be utilised as a tool to create a powerful brand and as a marketing tool (Preece et al. 2001; Preece and Suhaimi, 2009) because a strong online presence could enhance business performance (Cerdan and Acosta, 2005; Goi, 2012) as well as it contributes to overall growth of firms (Teo, 2005). Website adoption indicates strategic commitment to e-commerce and these initiatives improve firms' competitiveness (Teo and Pian, 2004).

Characteristics of Website Adopters

Firm size is the most likely drivers of e-commerce commitment, hence translated into website development (Kowtha and Choon, 2001; Simmons et al., 2009). Larger firms favour early entry because more often than not, they enjoy quicker access to capital and skills as well as they have some built-in capabilities. Teo and Pian (2004) supported this finding as

they too found that firm size has been substantially influenced the adoption of website as a strategic commitment to e-commerce.
Internet technologies such as website hold great promise in facilitating the internationalisation of small, knowledge-intensive firms (Prashantam and Young, 2004). It enables firms with limited resources to significantly reduce cost in communication because physical present is no longer necessary for effective communication with clients globally. Besides, website is effective for marketing and information sharing, both locally and beyond (Abari, 2011).

Barriers to Website Adoption

According to Walczuch et al. (2000), small firms were not adopting the internet with the same speed of the larger firms, although it could offer many advantages to them. Small businesses perceived that the website would not lead to more efficiency or lower cost and not suitable for a particular business because they failed to see the direct benefits out of this initiative, therefore reluctant to invest time and money in an internet presence. In a developing country of Oman, Alkalbani et al. (2012) found that lack of IT competent personnel, reluctance to change, security issues and financial constraints are the main barriers to adopt ICT in construction industry. Meanwhile, in Australian construction industry, limited resources in SMEs, lack of perceived return on investment on IT expenditure and lack of strategic planning are the organisational barriers for IT deployment (Stewart at al., 2004).

METHODOLOGY

Postal and online survey had been utilised to gather data in this research. The sampling frame was obtained from the website of the government body that governed the cost engineering practices in Malaysia. Questionnaires were sent to all 319 firms by postal. In effort to increase response rate, self-addressed envelope was enclosed in the postal survey and invitation to answer the survey online was sent to the respondents' e-mail. Respondents could choose to return the answered questionnaire either by post, online or 'scan and e-mail'. Despite of the convenience to send the answered survey, two reminders were sent by postal and online within four months of data gathering period. This research suffers a low response. Only 58 out of 319 questionnaires were returned, resulting in 18.1% response rate.

FINDINGS

Demographic

Table 1 shows the details of the participating firms. Majority of the respondents are non-adopters (72.4%) and 72.4% of the survey were answered by the top management personnel in their respective firm. In terms of firm category, 50% of the responses came from sole proprietorship firms.

Table 1: Respondents' Profile

Website Adoption	Adopter	27.6% (16)
	Non-Adopter	72.4% (42)
	TOTAL	100% (58)
Position	Top Management	72.4% (42)
	Manager	6.9% (4)
	Cost Engineer	20.7% (12)
	TOTAL	100% (58)
Firm Category	Sole Proprietorship	50.0% (29)
	Body Corporate	24.1% (14)
	Partnership	22.5% (13)
	Multi-Disciplinary	3.4% (2)
	TOTAL	100% (58)

Table 2 shows the intention of developing a website in the future among the website non-adopters. Majority (69.0%) would like to develop a website but still uncertain of the time while 11.9% are in the process of developing own website. However, 19.0% do not have the intention to develop a website for their firms.

Table 2: Intention of Developing Firms' Website in the Future

	Frequency	Valid Cases
Maybe, but uncertain of the time	29	69.0%
No intention of developing a website	8	19.0%
In the process of developing own website	5	11.9%
Total	42	100.0%
Missing Cases	16	
Total	58	

Characteristics of Adopter and Non-Adopter

Table 3 shows the details of adopter and non-adopter characteristics in five criteria namely firm age, firm size, average commission, source of project and involvement with overseas project. The mean value of firm age for adopters is 23 years while for non-adopters is 15 years. In terms of firm size, the average number of employee employed by adopters is 48 persons compared to 10 persons by non-adopters. Meanwhile, there is a huge difference in terms of average commission between adopters and non-adopters; RM19.5 million and RM4.1 million respectively. Apart from that, majority of adopters' source of project is from public and private sectors but majority of non-adopters' source of project is predominantly from public sector. Obviously, majority of adopters have been involved with overseas project and majority of non-adopters have never been involved with overseas project.

Table 3: Profile of Website Adopter and Non-Adopter

CHARACTERISTIC		Adopter	Non-Adopter	Mean / Mode
FIRM AGE	Less than 5 years	12.5% (2)	26.2% (11)	Mean Adopter: 23 years Non-Adopter: 15 years
	5 years and above	**87.5%(14)**	**73.8%(31)**	
	TOTAL	100.0% (16)	100.0% (42)	
FIRM SIZE	Small (1-10 persons)	25.0% (4)	**66.7% (28)**	Mean Adopter: 48 persons Non Adopter: 10 persons
	Medium (11-30 persons)	**50.0% (8)**	31.0%(13)	
	Large (> 30 persons)	25.0% (4)	2.4% (1)	
	TOTAL	100.0% (16)	100.0% (42)	
AVERAGE COMMISSION	< RM200,000	0.0% (0)	20.0% (6)	Mean Adopter: RM19.5 million Non-Adopter: RM4.1 million
	RM200,001-RM500,000	10.0% (1)	23.4% (7)	
	RM500,001-RM1,000,000	**30.0% (3)**	**43.3%(13)**	
	RM1,000,001-RM5,000,000	**30.0% (3)**	10.0% (3)	
	>RM5,000,000	**30.0% (3)**	3.3% (1)	
	TOTAL	100.0% (10)	100.0% (30)	
	Classified information	37.5% (6)	28.6% (12)	
SOURCE OF PROJECT	All / Majority projects are from public sector	**37.5% (6)**	**38.1%(16)**	Mode Adopter: Public & Private Non-Adopter: Public
	Equal portion of projects are from public & private sectors	25.0% (4)	26.2% (11)	
	All / Majority of projects are from private sector	**37.5% (6)**	35.7% (15)	
	TOTAL	100.0% (16)	100.0% (42)	
CHARACTERISTIC	**Adopter**	**Non-Adopter**	**Mean / Mode**	**CHARACTERISTIC**
INVOLVEMENT WITH OVERSEAS PROJECT	Yes	**68.8%(11)**	21.4% (9)	Mode Adopter: Yes Non-Adopter: No
	No	31.3% (5)	**78.6%(33)**	
	TOTAL	100.0% (16)	100.0% (42)	

Determinants of Website Adoption

Table 4 shows the results of the statistic tests to determine the significant difference and correlation strength between the five criteria and website adoption. The results show that firm size, average commission and involvement with overseas project have significant difference on website adoption. Then, correlation tests indicate that there are medium strength correlations between these three criteria and website adoption respectively. On the other hand, firm age and source of project do not have significant differences on website adoption, therefore are not tested for correlation.

Table 4: Determinants of Website Adoption

Variables	Significant Difference	Correlation Strength
Firm Age	Z= -1.108, p>0.05 (Not significant)	-
Firm Size	Z=-3.183, p<0.05** (Significant)	r(58) = -0.422*, p<0.05; r^2= 0.178 (Medium strength)
Average Commission	Z= -2.879, p<0.05** (Significant)	r (40) = -0.464**, p<0.05; r^2=0.215 (Medium strength)
Source of Project	χ^2(2, N=58) = 0.018, p> 0.05 (Not significant)	-
Involvement With Overseas Project	χ^2(1, N=58) = 11.484, p<0.05** (Significant)	r(58) = -0.445*, p<0.05; r^2=0.198 (Medium strength)

Inhibition Factors on Website Adoption

Table 5 shows the ranking of inhibition factors on website adoption. 'Not lead to more efficiency or lower cost', 'not lead to more commission' and 'lack of time' are the top three factors in rank, followed by 'sceptical on cost vs ROI', 'have other priorities' and 'lack of IT expertise'. Meanwhile, factors namely 'afraid of organisational change', clients not using the internet' and 'unaware of internet marketing practices' are the bottom three in the rank.

Table 5: Inhibition Factors on Website Adoption

Inhibition Factors	Mean (Standard Deviation)	Rank
Not lead to more efficiency or lower cost	3.57 (0.63)	1
Not lead to more commission	3.55 (0.63)	2
Lack of time	3.48 (0.86)	3
Skeptical on cost vs ROI	3.48 (0.83)	4
Have other priorities	3.40 (0.73)	5
Lack of IT expertise	3.33 (0.93)	6
Doubtful regarding e-transaction	3.31 (0.95)	7

Inhibition Factors	Mean (Standard Deviation)	Rank
security		
Troublesome to have website and to maintain it	3.31 (0.92)	8
Doubtful regarding the security of personal / confidential information	3.31 (0.87)	9
High maintenance cost	3.29 (0.77)	10
Not suitable due to nature of business	3.26 (0.89)	11
Unclear regarding cyber law	3.19 (0.83)	12
High initial cost	3.12 (0.83)	13
Sufficient number of clients	2.98 (0.87)	14
Technically too complicated	2.79 (0.87)	15
Never thought of having a website	2.76 (0.91)	16
Sceptical of technology change	2.74 (0.91)	17
Afraid of organisational change	2.48 (0.86)	18
Clients not using the internet	2.43 (0.97)	19
Unaware of internet marketing practices	2.19 (0.89)	20

DISCUSSION

The Rate of Website Adoption

The rate of website adoption among Malaysian cost engineering firms is 27.6%. This percentage shows an encouraging increment where in 2002, the adoption rate in Malaysian construction industry at large was 24% (Mui et al., 2002) and in 2007, the adoption rate among Malaysian quantity surveying firms was 19.2% (Abdullah and Haron, 2007). Furthermore, Alam and Ahsan (2007) argued that the website adoption rate among Malaysian SME service firms was at 9.4% in 2007. Eventhough the pace of adoption is relatively slow among cost engineering firms, this pattern is consistent with Alam and Ahsan (2007) statement that the Malaysian SMEs are slow in adopting a website for businesses. In comparison, website adoption in architectural practices in Western Cape has been increasing from 17.5% in 2000 to 42.6% in 2012 (Grosskurth et al., 2012). Meanwhile, the e-commerce adopters in Singapore have been reached 52.8% in 2004 (Teo and Ranganathan, 2004). In Netherland, Walczuch et al. (2000) stated that 21% of Dutch small firms have had a website and this figure would be increasing as the upgrading of internet access was in progress.

The percentage of website adoption in Malaysian cost engineering firms would likely to increase in the future as almost 12% of the non-adopters are in the process of developing a website for their firms and almost 70% expressed the intention to develop a website for their businesses. These figures indicate that awareness on opportunities offered by website among the practices have been increased almost four folds in 10 years duration as Mui et al. (2002) found out that, in 2002, only 21% of the construction-related firms in Malaysia had the planning to develop a website for their firms in the future.

Fierce competition in the construction service sector due to liberalisation and globalisation could have been the push factors to encourage the practitioners to rethink their strategies to be competitive and more visible in the ever dense market. Construction-related-service market is not only flooded with new entries from local fellows but also receive entrance from highly competitive companies from overseas (Abidin et al., 2011). Website is a multi-purpose tool that enable small firms to be at par with their larger counterparts (Walczuch et al., 2000); a showcase of firm image and reputation (Xi et al., 2007), could be integrated with other applications and serves as a project collaboration platform (Redmond et al., 2012), as well as an effective medium for communication (Yong et al., 2012). Somehow, by having a website, the firms convey message to the potential clients that they are technology savvy and up-to-date with the current trend in doing business (Armstrong and Durkin, 2008; Kowtha and Choon, 2001).

The Profile of Website Adopters and Non-Adopters

In order to understand the website adoption trend among the Malaysian cost engineering firms, preliminarily, it is useful to comprehend the adopters and non-adopters profiles. In this research, data regarding firm age, firm size, average commission, source of project and involvement with overseas project are selected to depict the profiles.

The result shows that the adopter firms have been existed longer in practice, they have a larger pool of resources in terms of manpower and financial, their source of projects is predominantly from both sources; public sector and private sector and majority have been involved with overseas project (see Table 3). In comparison, the non-adopter firms are younger firms with smaller pool of staff and financial resources, more dependent on public projects and majority have never been involved with overseas project. In terms of firm age, this finding is consistent with Hoskinsson et al. (2008) that found more established firms are more effective in exploiting the identified opportunities while younger firms are more effective in identifying opportunities and producing radical innovations. Furthermore, by reckoning the entrepreneurial opportunities offered by the website, the larger firms could have more capabilities and resources to utilise the website for the benefits of their firms. This finding is consistent with Teo et al. (2009) findings that firms with larger pool of staff and higher annual revenue are associated with the adoption of e-procurement. The advantages in resources especially manpower and financial enable larger firms to allocate more skills and higher budget on their IT initiatives to ensure its effectiveness. Besides, they have a greater need to keep ahead in technologies advances to remain competitive compared to the smaller firms.

The source of project among adopter firms is predominantly from both sectors namely public and private, meanwhile the non-adopter firms are more dependent on public projects. References on this matter cannot be found and it is a new variable tested in this research. Nevertheless, a plausible reason could be that the adopter firms are more visible in the market and their experiences and reputation are displayed on the website for reference. Potential clients from private sector could have easily accessing the firms' information via the website and contact the firm for further actions. Apart from that, majority of adopter firms have been involved with overseas project compared to non-adopters firms and this indicates that having a website could be a strategic move for expanding beyond local boundaries. Since an excellent track record is the most important factor relative to internationalisation (Gunham

and Arditi, 2005), website is an effective tool to canvass the firms' track record as well as firms' image and reputation globally. This advantage could have been fully utilised by the adopter firms to market their service and project their firms' image, hence increase the chances to be shortlisted by clients in other countries.

The Determinants of Website Adoption

Statistic results show that, out of five determinant variables tested, three variables positive for significant differences namely firm size, average commission and involvement with overseas project, while firm age and source of project are not significant (See Table 4). The significant variables also tested for correlation strength and each has medium strength correlation with the adoption of website initiative.

The propensity to adopt a website is associated with large firms, indicated by the number of employees and internationalisation move. This finding is consistent with other research in most ICT and IT adoption and internationalisation of service firms (Aziz et al., 2012; Hadaya and Pellerin, 2010; Teo et al., 2009). In order to grow and expand overseas, website could have been an important tool, initially for marketing and reputation exposure, then as a communication platform and collaboration stage for all team members in a project. Furthermore, the adoption of website is also associated with higher average commission. Possibly, website could be the kick-start in firm growth; easily spotted via search engine, convincing reputation displayed on the website and easily contacted via email or by telephone.

Inhibition Factors on Website Adoption

As mentioned above, Malaysian cost engineering consultant is slow in adopting website. Almost 70% of non-adopter firms have the intention to develop a website for business and this indicates that Malaysian cost engineering firms recognised the entrepreneurial opportunities offered by website. Nevertheless, the current overall non-adoption rate is still more than 70%.

The adoption of website among cost engineering firms in Malaysia have been hindered by the perception that website will not lead to more efficiency, lower cost or more commission. Besides, "lack of time" and "skeptical on cost versus return on investment" are the major concerns that hampering the intention of non-adopter firms to develop a website for their firms. These findings are consistent with other research (Alkalbani et al., 2012; Stewart et al, (2004; Walczuch et al., 2000). Previous study by Mui et al. (2002) showed that 'time consuming' and 'high initial cost' are the major factors that hindered the website adoption initiatives in Malaysian construction industry. Eventhough 'time constraint" is still a relevant factor, high initial cost is no longer a major concern to adopt a website.

The concerns pertaining to website adoption are relevant as majority of non-adopter firms are small in size, therefore constraint in resources especially manpower and financial are inherent with them. Inability to measure the tangible benefits especially in terms of financial out of the initiatives increased the perceive 'not lead to more efficiency, lower cost or more commission' and 'skeptical on cost versus return on investment'. Small firms need to be extra careful with their financial budget and physical evidence on financial returns has always

been the major consideration before making any decision on innovation adoption initiatives. Lack of time to manage the website is another issue in adopting a website due to the small number of employees, but hiring IT staff to manage the website will incur extra cost in operation. More often than not, the existing employees have their hands full with the core business and having a website might be seen as unnecessary extra load to the employees.

SUMMARY AND MANAGEMENT IMPLICATION

The website adoption rate in Malaysian cost engineering firms is 27.6%, and this figure will likely to increase in the nearest future as almost 12% is developing a website for their firms and 69% have intention to develop own website. In terms of profiles, adopter firms have been longer in establishment, consist of larger firms, enjoy higher average commission, projects are predominantly from private and public sector and have been involved with overseas project compared to non-adopter firms. Moreover, website adoption initiative is associated with larger firms, higher commission and involvement with overseas project. Non-adopter firms perceived that website adoption initiatives 'do not lead to more efficiency or lower cost', 'do not lead to lower cost', 'lack of time' and 'skeptical on cost vs ROI' have been major inhibition factors that hindered the adoption.

This study could be an indicative guideline for cost engineering firms to decide on website adoption for business. The adoption of website is associated with larger firms, higher average commission and involvement with overseas project. These indicate that website could have been one of the influences that speed up business growth and expansion beyond the local boundaries. At the very least, the adoption of website could be a virtual brochure for firms to market their services locally and globally.

CONCLUSION

Combination of click-and-brick promises huge entrepreneurial opportunities for business including knowledge-intensive services like cost engineering services. Despite the hype of website benefits in today's business landscape, the adoption rate in Malaysian cost engineering firms is relatively low and slow. The benefits are intangible and difficult to measure, hence increase the pessimism over the website adoption initiative. Nevertheless, majority of adopter firms enjoy business growth, higher commission and have been involved with overseas project. Website is a medium that is relatively cheap, multi-purpose and able to reach potential clients around the globe in seconds. Therefore, developing a website should be one of the strategic business moves that might be kick-start to business expansion and prosperity.

REFERENCES

1. Abari, S.O. (2011), "The role of website in company marketing: Innoventum Oy strategies for entering the Irish ICT market", *Published Thesis*, North Karelia University of Applied Sciences, Findland.
2. Abdullah, F. and Haron, I. (2007), "Profile of quantity surveying practice in Malaysia", Paper presented at the *International Conference on Construction Industry on June 21-25, 2007*, jointly organised by Universiti Teknologi Malaysia and Universitas Bung Hatta, Padang, Indonesia.

3. Abidin, N.Z., Yusof, N., Hassan, H., and Adros, N.A. (2011), "Applying competitive strategy in quantity surveying firms: an evolving process", *Asian Journal of Management Research,* Vol.2, Iss. 1, pp. 61-73.
4. Alam, S.S., and Ahsan, N. (2007), "ICT adoption in Malaysian SMEs from services sectors: Preliminary findings", *Journal of Internet Banking and Commerce,* Vol 12, No. 3, pp. 1-11.
5. Alkalbani, S., Rezgui, Y., Vorakulpipat, C. and Wilson, I.E. (2012), "ICT adoption and diffusion in the construction industry of a developing country: The case of the sultanate of Oman", *Architectural Engineering and Design Management,* pp 1-14. DOI:10.1080/17452007.2012.718861.
6. Aziz, A.R.A., Azmi, H.A.C.M.N., Law, Y.H. and Pengiran, D.N. (2012), "Internationalisation of construction-related consultants: Impact of age and size", *Journal of Professional Issue in Engineering Education and Practice,* Vol. 139, Iss. 2, pp. 148-155.
7. Cerdan, A.L.M., & Acosta, P.S. (2005), "Examining e-business impact on firm performance through website analysis", *International Journal Electronic Business,* Vol.3, No. 6, pp. 583-598.
8. Goi, C.L. (2012), "The impact of website development on organisation performance: Malaysia's perspective", *African Journal of Business Management,* Vol. 6(7), pp. 2435-2448.
9. Grosskurth, L.K., Haydam, N.E., and Karam, A. (2012), "The internet as a marketing tool for professional services: The case of architectural in the Western Cape", *Asian Journal of Business and Management Sciences,* Vol. 2, No. 5, pp. 27-42.
10. Gustavsson, T. K., Samuelson,O. and Wikforss, O. (2012), "Organizing IT in construction: Present state and future challenges in Sweden", *Journal of Information Technology in Construction,* Vol. 17, pp. 520-534.
11. Hoskisson, R.E., Hitt, M.A., Ireland, R.D., and Harrison, J.S. (2008), "*Competing for advantage, 2nd edition",* US: Thomson South-Western.
12. Kowtha, N.R., and Choon, T.W.I. (2001), "Determinants of website development: A study of electronic commerce in Singapore", *Information & Management, 39,* pp. 227-242.
13. Mui, L. Y., Aziz, A. R. A., Ni, A. C., Yee, W. C., and Lay, W. S. (2002), "A survey of internet usage in the Malaysian construction industry", *Journal of Information Technology in Construction,* Vol 7, pp. 259-269.
14. Hadaya, P., and Pellerin, R. (2010),"Determinants of construction companies' use of web-based interorganizational information systems", *Supply Chain Management: An International Journal,* Vol. 15 Iss: 5 pp. 371 – 384
15. Porter, M.E. (2001), "Strategy and the internet", *Harvard Business Review,* Vol 79, No. 3, pp. 63-78.
16. Prashantham, S., and Young, S. (2004), "The internet and the internationalization of small knowledge-intensive firms: Promises, problems and prospects", *International Journal of Entrepreneurship and Small Business*, Vol. 1, N 1/2, pp. 153-175.
17. Preece, C., and Suhaimi, M.S.N.M. (2009), "The effectiveness of Malaysian QS practices' websites as a part of corporate branding strategies", Paper presented at the *13th Pacific Association of Quantity Surveyors Congress on August 17-18, 2009*, jointly organised by the Institute of Surveyor Malaysia, Kuala Lumpur, Malaysia.
18. Preece, C., Moodley, K. and Cox, I. (2001), "Assessing the effectiveness of websites as an interactive business communication tool", In Akintoye, A. (Ed.), in *17th Annual ARCOM Conference Vol. 1*, Association of Researchers in Construction Management: University of

Salford, pp. 207-217.

19. Redmond, A., Hore, A., Alshawi, M., and West, R. (2012), "Exploring how information exchanges can be enhanced through cloud BIM", *Automation in Construction 24*, pp. 175-183.
20. Simmons, G., Armstrong, G.A. and Durkin, M.G. (2008), "A conceptualization of the determinants of small business website adoption: Setting the research agenda", *International Small Business Journal,* Vol 26(3), pp. 351-389.
21. Stewart, R.A., Mohamed, S., and Marosszeky, M. (2004), "An empirical investigation into the link between information technology implementation barriers and coping strategies in the Australian construction industry", *Construction Innovation,* 4(3), pp. 155-171.
22. Suat Gunham and David Arditi, (2005), "Factors affecting international construction", *Journal of Construction Engineering and Management,* pp. 273-282.
23. Teo, T.S.H. (2005), "Usage and effectiveness of online marketing tools among business-to-cunsumer (B2C) firms in Singapore", *International Journal of Information Management,* Vol. 25, pp. 203-213.
24. Teo, T.S.H., and Pian, Y. (2004), "A model for web adoption", *Information & Management 4,* pp. 457-468.
25. Teo, T.S.H., and Ranganathan, C. (2004), "Adopters and non-adopters of business-to-business electronic commerce in Singapore", *Information and Management 42*, pp. 82-102.
26. Teo, T.S.H., Lin, S. and Lai, K.H. (2009), "Adopters and non-adopters of e-procurement in Singapore: An empirical study", *Omega 37,* pp. 972-987.
27. Tsikriktsis, N., Lanzolla, G. and Frohlich, M. (2004), "Adoption of e-processes by service firms: An empirical study of antecedents", *Production and Operation Management,* Vol. 13, No. 3, pp. 216-229.
28. Walczuch, R., Braven, G.V., and Lundgren, H. (2000), "Internet adoption barriers for small firms in the Netherlands", *European Management Journal,* Vol. 18, No. 5, pp. 561-572.
29. Xi, Y.M., Zhuang, Y., Huang, W., She, C., and Zhang, Z. (2007), "The quality and content analysis of corporate websites in China: An empirical study", *International Journal of Information Technology & Decision Making,* Vol. 6, No. 2, pp. 389-405.
30. Yong, L., Chunlai, C., and Caiyun, C. (2012), "Study on web-based project integrated management information system in AEC industry", *Journal of Software,* Vol. 7, No. 8, pp. 1713-1720.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

Title:

Website Adoption: Overview of Malaysian Cost Engineering Firms

Author:

Ms. Zarina Syuhaida Shaarani
Student, MSc. (Quantity Surveying),School of Housing, Building and Planning,
Universiti Sains Malaysia, Penang, Malaysia.

Lecturer, Civil Engineering Department,
Politeknik Tuanku Sultanah Bahiyah, Kulim, Kedah, Malaysia.

Qualification:
Msc. Quantity Surveying, Universiti Sains Malaysia, Malaysia (by April 2013).
BSc. Housing, Building and Planning (Construction Management)(Hon), Universiti Sains Malaysia.
Diploma in Education, Maktab Perguruan Teknikal, Malaysia.

Corresponding: +60194575833
E-Mail: zarin.aida7373@gmail.com

Co-Author:

Prof. Sr. Dr. Abdul Rashid Abdul Aziz
Lecturer, School of Housing, Building and Planning,
Universiti Sains Malaysia.

E-Mail: arashid@usm.my

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

SYSTEM SUPPORTING LOCATION OF SERVICE WORKS - CASE STUDY

Jędrzej Trajer, Department of Production Engineering, Warsaw University of Life Sciences, Poland
Email: jedrzej_trajer@sggw.pl

Małgorzata Jaros, Department of Production Engineering, Warsaw University of Life Sciences, Poland
Email: malgorzata_jaros@sggw.pl

Bronisław Gołębiewski, City of Warsaw Hall, Transport License & Permit Department, Poland
Email: bgolebiewski@um.warszawa.pl

Radosław Winiczenko, Department of Production Engineering, Warsaw University of Life Sciences, Poland
Email: radoslaw_winiczenko@sggw.pl

ABSTRACT

Purpose: The purpose of this work was to propose a new approach to assess the influence of decision variables on the running costs of networks providing services, taking recycling networks as an example. The authors have analyzed the importance of these variables and the trends in these changes.
Design / methodology / approach: A computer system supporting decisions about the location of ELVs recycling network facilities, which indicates globally optimum locations of all facilities, was applied. An analysis of output variables sensitivity: location and cost of recycling on decision variables changes, i.e. the ELVs stream, and cost components connected with recycling was performed. The results of the analysis were presented in the form of graphs showing the relation between the cost of recycling generated by the network in the period of one year and the changes in the cost of transport, storage and dismantling of ELVs as well as the transport of dismantled parts and materials.
Findings: The approached proposed by the authors allows to reject insignificant decision variables (it simplifies decision-making) and identifies the values which have the greatest impact (shortens decision-making for alternative data variants).
Practical implications: The proposed approach allows to specify the values of decision variables, and provides information required for the evaluation of profitability of the recycling network.
***Originality / value*:** The proposed approach allows to assess the relationship between the cost of recycling and decision variables at a general level - the territory being analyzed in the period of one year, and at a detailed level - the cost of recycling one vehicle.

Keywords: system supporting location, case study, vehicle recycling, sensitivity analysis

INTRODUCTION

The location problem has been known for a long time, and it is discussed while planning networks of a certain kind of facilities (objects). When designing a network, we wish to select the locations of the objects that belong to the network so as to optimize the function that characterizes the location of all the objects that make up the network. Due to the huge variety of networks, the solution to the problem is sought in each case individually. The development of IT techniques created new possibilities concerning the optimization of the location of objects in the spatial structure of the system being designed or managed. There are various models and methods of optimization, including linear programming and sophisticated heuristics, depending on the complexity of the problem.

Recently, there have been published a lot of work concerning the location problem, e.g. location of product distribution centres with respect to selected parameters of the process, most frequently minimization of the distance. There were developed models taking into account a different number of products (multi-product) (Nozick and Turnquist, 2001) and different methods of distribution (Nonås and Jörnsten, 2007) and (Weiwei Gong *et al*. 2007). (Daskin *et al*., 2002) and (Zuo-Jun *et al*., 2007) formulated this problem in the form of a nonlinear integer programming model and used Lagrangian relaxations. Various tools were used to solve the model depending on the degree of the model complexity (Shu *et al*., 2005) - Column Generation Method. (Ek Peng Chew *et al.*, 2002) used genetic algorithms to solve the problem of location and took into consideration the cost of the distribution process and the quantity of stocks. Given random changes of distribution process parameters, the quantity of stocks may be assessed using computer simulation, (Miranda and Garrido, 2006) and Monte Carlo methods, (Kwilosz, 2011).

The above research do not analyze the influence of individual decision variables in the model on the assessment indexes of the networks designed. Such analysis might simplify the structure of the network model as well as shorten the time required to assess solutions. A similar idea regarding improvement of simulation research was proposed in transport problem by KwangSup Shin *at al.,* 2012. The paper proposes a simulation method using genetic algorithms for the optimal location of objects of the network, with a limited site selection. Here, the location is understood as a spatial organization of objects of the network in the topographical sites to choose from, within the specified industrial/administrative area (country/macroregion). In order to assess the importance of selected decision variables, sensitivity analysis was applied to study their influence on the cost of recycling.

FORMULATION OF THE OPTIMIZATION TASK

Appropriate location of the objects of recycling network in Poland, conforming to general criteria of providing services (including both local and European Union regulations), should facilitate the development of this kind of business activity. The optimization problem regarding the studied case is complex and includes:

- linear and non-linear problems,
- problems not defined formally,
- huge spaces of possible solutions,

- operating on sets of possible solutions and not on values of individual decision variables,
- no model solutions,
- seeking a global optimum for systemic selection of the location of objects in a network, instead of the optimum location of a single object in a network.

With regard to the above, seeking an optimum solution by means of non-classical methods seemed justified. Recycling is an environment friendly and cost-effective way of end-of-life vehicle (ELVs) utilization. The authors assumed 3-level organization of a recycling network. The network consists of the following objects: vehicle collection points, dismantling stations and processing facilities. The cost of recycling depends on the cost of transport of vehicles, parts and materials between the facilities (objects) of the system. Therefore, the location of each object should be correlated with the locations of other objects of the network.

The general form of the objective function and the optimization criterion for the presented case has the following form:

$$K_{rec} = f(K_s, K_m, K_d, K_c) \rightarrow \min \tag{1}$$

and individual costs depend on the following variables:

$$K_s(k_s, Q_j, a(\mathrm{i,j})),\ K_m(k_s, \sum_{j=1}^{N} Q_j),\ K_d(k_d, \sum_{j=1}^{N} Q_j),\ K_c(k_c, S_k, a(j,l))$$

$N \geq J \geq 1,\ L \geq 1$

where:

i=1,…,N - number of vehicle collection points,

j=1, …, J - number of vehicle dismantling stations,

l=1, …, L - number of processing facilities,

K_s, k_s – the total cost and the unit cost of transport ELVs, PLN/year, PLN/t km,

K_c, k_c - the total cost and the unit cost of transport of parts and materials, PLN/year, /t km

K_d, k_d - the total cost and the unit cost of dismantling, PLN/year, PLN/psc.

K_m, k_m – the total cost and the unit cost of storage, PLN/year, PLN/psc.

Q_i - stream of vehicles transported from vehicle collection point VCP_i to dismantling station

DS_j, psc./day

S_k – stream of materials and parts transported to processing facility PF_k, t/day

a(i,j), **a**(j,l), – matrices of transport distances, km.

Consequently, the optimization task involves the determination of the cost of recycling depending on the stream of vehicles Q_j, and such locations $\mathbf{a}(i,j)_{min}$ and $\mathbf{a}(j,l)_{min}$ of facilities in the region that the total cost of transport which also depends on Q_j is minimized. A computer system supporting selection of the location was developed for this purpose, (Gołębiewski, 2011). The principle of operation of the system supporting the selection of the location of vehicle dismantling stations is presented in Fig. 1.

"Take in Figure (No.1)"

The system has the following output variables: daily stream of vehicles, number and location of vehicle collection points (determined by the criteria adopted for the selected region), number and location of processing facilities and cost components connected with recycling. The location and number of dismantling stations are determined using genetic algorithms, to minimize the cost of recycling.

RESULTS OF SIMULATIONS AND DISCUSSION

The following parameters of the optimization task were identified in the analyzed case study: $J \leq 37$, $k_m(Q_j>30)=2.50$ [PLN/psc.] ; $k_d=205+334\exp(-0.124Q_j)$, PLN/psc.; $k_s=1.62$ [PLN/tkm]; $k_c= 2.21$ [PLN/tkm]; distances $\mathbf{a}(i,j)$ and $\mathbf{a}(j,l)$ were determined based on the current maps of the region.

The results of simulated locationns of dismantling stations for selected input variables were presented graphically: on the maps of the province and in the form of graphs. The diagram in fig.2. presents the system of simulation experiments; the symbol w_p denotes a coefficient change of the unit the cost components.

"Take in Figure (No.2)"

Comparative analysis was based on the cost of recycling calculated for the maximum stream of vehicles directed to all recycling stations in the Mazovia province and other parameters identified for this area, $K_{rec}=f(Qmax, PF_{pd}, k_S, k_d, k_m, k_c)$.

The obtained values of K_{rec} for the identified data that constitute the basic set of data in the conducted research, were presented in fig. 3. The result K_{rec} considered the best, due to the value of the adaptation function, was obtained after 71 iterations - generations. Stations are located in seventeen (J = 17) district towns.

"Take in Figure (No.3)"

The sensitivity (Tarnowski and Kiczkowiak, 2006) of the developed system was analyzed by studying the influence of percentage changes (w_p) of the objective function components, i.e. cost connected with the following: transport of vehicles K_S, transport of parts and materials K_C, dismantling K_d and storage K_m on percentage changes of the total cost of recycling.
The analysis of sensitivity presented in fig. 4, 5, 6 significantly depends on the cost connected with transporting parts and materials and the cost of dismantling, whereas the cost connected with transport and storage of vehicles are less significant.

"Take in Figure (No.4)"

"Take in Figure (No.5)"

"Take in Figure (No.6)"

Changes in the cost connected with transport of parts and materials have the greatest influence on the cost of recycling, which is a consequence of long distances between stations and processing facilities.

The influence of changing the location of processing facilities on the location of dismantling stations - DS was also studied. The basic variant, presented in Fig.7.A. and in Fig.7.B., assumes that materials and parts are transported to processing facilities located south of the area being analyzed.

"Take in Figure (No.7)"

Fig.7. shows the consequences of locating these facilities north of the Mazovia province. DS located in the same places on maps A and B in Fig.7. are marked by the symbol ●.

CONCLUSIONS

The results of the sensitivity analysis, shown in figs. 4,5 and 6, provided both the information that is easy and difficult to anticipate a priori. The cost of transport of parts and materials have the greatest impact on the cost of recycling, which can be attributed to considerably long distances between dismantling stations and processing facilities. The cost of dismantling ELVs also has a considerable influence on the total cost of recycling, while the costs of storage and vehicle transportation are negligible due to small number of stored vehicles and short distances between collection points and dismantling facilities. Given the specified constraints of the case being analyzed, the global cost of connected with the recycling network operation considerably depend on the number of dismantled vehicles. A percentage change in the cost of recycling depending on the cost components depends to a little extent on the demand for the services being analyzed, provided that the objects of the recycling network have the optimum locations in the given area. Similarly, if the objects of the recycling network have optimum locations, the average cost of recycling one vehicle do not depend on the demand for this type of services, which, in case of conducting this type of activity, has a considerable importance in assessing its profitability.

REFERENCES

1. Daskin M., Coullard C., Shen Z.J. (2002), "An inventory-location model: formulation, solution algorithm and computational results", *Annals of Operations Research* 110, pp. 83-106.
2. Ek Peng Chew, Loo Hay Lee, Kanshukan Rajaratnam. (2002), "Evolutionary algorithm for an inventory location problem", *Studies in Computational Intelligence* 49, pp. 613-628.

3. Gołębiewski B. (2011), "The intelligent system supporting location of service works on example of vehicle recycling network". Doctoral Dissertation. Warsaw University of Life Sciences, Warsaw, 22 March.
4. KwangSup Shin, YongWoo Shin, Ji-Hye Kwon, Suk-Ho Kang. (2012), "Risk propagation based dynamic transportation route finding mechanism", *Industrial Management and Data Systems,* Vol.112 ISS:1, pp. 102-124.
5. Kwilosz T. (2011), "The use of the statistic methods in UGS strategic gas reserves estimation based on uncertainties connected to pressure in gas pipelines and gas storage production rates", *Nafta-Gaz*, R 67, No 3, pp. 192-197. (in Polish)
6. Miranda P.A., Garrido R.A. (2006), "A simultaneous inventory control and facility location model with stochastic capacity constraints", *Networks and Spatial Economics*, Vol.6, No1, pp. 39-53.
7. Nonås L.M., Jörnsten K. (2007), "Optimal solutions in the multi-location inventory system with transshipments", *Journal of Mathematical Modelling and Algorithms* 6, pp. 47-75.
8. Nozick L.K., Turnquist M.A. (2001), "A two-echelon inventory allocation and distribution center location analysis", *Transportation Research, Part E: Logistics and Transportation Review* 37(6), pp. 425-441.
9. Shu J., Teo C.P., Shen Z.J. (2005), "Stochastic transportation-inventory network design problem", *Operations Research* 53, pp. 48-60.
10. Tarnowski W., Kiczkowiak T. (2006). „Optimization and computer-aided design", Wydawnictwo Uczelniane Politechniki Koszalińskiej, Koszalin, (in Polish).
11. Weiwei Gong, Daoliang Li, Xue Liu, Jun Yue, Zetan Fu (2007), "Improved two-grade delayed particle swarm optimisation (TGDPSO) for inventory facility location for perishable food distribution centres in Beijing", *New Zealand Journal of Agricultural Research*, Vol. 50, pp. 771-779.
12. Zuo-Jun, Max Shen, Lian Qi. (2007), "Incorporating inventory and routing costs in strategic location models", *European Journal of Operational Research* 179(2), pp. 372-389.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

SYSTEM SUPPORTING LOCATION OF SERVICE WORKS - CASE STUDY

Authors:
Jędrzej Trajer[1], Małgorzata Jaros[1], Bronisław Gołębiewski[2] , Radosław Winiczenko[1]

Affiliations:

Jędrzej Trajer, SGGW University Professor, was born in Poland in 1955. He received the M.Sc., and PhD degrees in mechanical engineering from Warsaw University of Technology and doctor habilitated degree in agriculture engineering from the Institute of Technology and Life Sciences, Warsaw, Poland in 1973, 1984 and 2002, respectively. He is the head of the Department of Fundamental Engineering at the Faculty of Production Engineering of Warsaw University of Life Sciences. He is the author of ca. 100 works covering multi-aspect modelling problems of complex technical and agricultural systems as well as decision support using sophisticated IT solutions such as artificial intelligence methods, data mining and hybrid systems. A member of Polish Society of Production Management and a member of the management board of the Polish section of EFITA (European Federation for Information Technology in Agriculture, Food and the Environment).
e-mail: jedrzej_trajer@sggw.pl

Małgorzata Jaros, Professor was born in 1953 in Poland. She received the M.Sc. degree in applied mathematics from University of Warsaw, PhD degree in agriculture engineering from Warsaw University of Life Sciences and doctor habilitated degree in agriculture engineering from University of Life Sciences in Lublin, Poland in 1977, 1992 and 1999, respectively. She is Professor at the Department of Production Engineering of Warsaw University of Life Sciences and a President of the Warsaw branch of Polish Society of Agricultural Engineering. Her interests cover systems engineering, applied mathematics, methodology and drying technology.
e-mail: malgorzata_jaros@sggw.pl

Bronisław Gołębiewski, PhD was born in Poland in 1970. In 1998, he graduated from the Faculty of Transport of the Warsaw University of Technology and received the M.Sc. degree (speciality: exploitation and maintenance of motor vehicles). In 2003 he participated in a training on vehicles recycling at the Industrial Research Institute for Automation and Measurements in Warsaw. He completed doctoral studies at the above mentioned faculty, and received a PhD in march 2011 from the Faculty of Production Engineering of Warsaw School of Life Sciences. Currently, he holds the position of the Chief Specialist in the City of Warsaw Hall and grants licences for providing domestic road transport.
e-mail: bgolebiewski@um.warszawa.pl

Radosław Winiczenko, PhD was born in Poland in 1971. He received the MSc and PhD degrees in the mechanical engineering from the University of Technology and Life Sciences in Bydgoszcz and from the Warsaw University of Technology, in 1997 and 2001. Between 1997-2001, he worked as a postdoc at the Department of Production Engineering of Warsaw University of Technology. From 2002 to 2003, he served as a research-assistant at the Department of Production Engineering of Warsaw University of Life Sciences. In 2003, he was appointed an assistant professor of Warsaw University of Life Sciences at the

Department of Production Engineering and he currently holds this position. His current research interests cover evolutionary algorithms, and optimization in production engineering.
e-mail: radoslaw_winiczenko@sggw.pl

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

A STUDY ON THE ADOPTION OF CLOUD TECHNOLOGY SERVICE IN TOURISM

Shu-Ping Lin, Department of Technology Management, Chung-Hua University
Hsin-Chu 300, Taiwan ROC, splin@chu.edu.tw

Shou-Yen Lin*, PH.D. Program of Technology Management, Chung-Hua University
Hsin-Chu 300, Taiwan ROC,
Department of Digital Media Design, Chungyu Institue Technology,
Keelung 201,Taiwan ROC
rbfmds@gmail.com

ABSTRACT

Tourism is considered the "super star" industry with most growth potential in the 21st century. It is expected to bring huge economical benefits, and would be what countries in the world compete for. With the rapid development in technology, services provided by cloud technology have become increasingly diverse. One of the major areas for applying cloud service is to integrate it within travel industry to provide a value added service. Taiwanese government has been actively promoting local tourism. For example, the Taipei City Government utilizes cloud technology to promote itself as a smart city, using "MOTA (Map of Taipei Amusement)", a map based interactive guiding tool to deliver rich location based information. To understand how users take advantage of cloud technology, this study aims to construct a tourist cloud service accept behavior system (TCSAB) based on three elements, including innovation diffusion, the technology acceptance model, and media richness. Through an extensive literatures review, theories relevant to innovation service (i.e., reasoned action theory, innovation diffusion theory, and technology acceptance model), and to media richness (i.e. media richness theory, enjoyable experience) will be extracted in the TCSAB system. This study uses questionnaire to collect data. Structural Equation Modeling (SEM) is adopted to analyze the data to clarify the determinants influencing users' intention of tourist cloud service. Some implications from our results will be discussed and be expected as a reference for promoting the tourist industry in the future.

Keyword: cloud services, innovation diffusion, media richness, Structural Equation Modeling (SEM), tourist cloud service accept behavior (TCSAB)

LITERATURE REVIEW

Innovation Technology acceptance model

The MOTA system is an integrated technical service that applies the users for tourism information researching. The technology acceptance model (TAM) predicts consumers' acceptance of technical products or services. It was developed from the Theory of Reasoned Action (TRA) and was first proposed by Davis (1989). The TAM includes five constructs related to the use of technology, namely, perceived ease of use (PEOU), perceived usefulness (PU), attitude towards use (ATT), behavioral intention to use (BI), and actual behavior on use (AU). Among these, PU and PEOU are the most dominant determinants for system adoption. Furthermore, PEOU has a direct influence on PU. ATT directly influences a user's BI, which determines actual system adoption.

Innovation diffusion primarily focuses on exploring how business should develop and promote innovation to increase consumer intention to accept or adopt such innovations. As Meyer and Goes (1988) highlighted in their study, to understand, evaluate, use, adopt, and diffuse innovations are the necessary steps for diffusing innovations within an organization. IDT proposed by Rogers (1995) explains how individuals adopt new ideas or innovations.

Additional social influences: Social influence was defined as the social information that individuals received from innovation adoption by others. Peres, Muller and Mahajan (2010) pointed that social influences are transmitted to other individuals, who follow the consumption behavior of people in their aspiration groups. In particular, these influences are observed by potential adopters who infer from them the social consequences of adoption.

Due to the effectiveness of IDT in explaining innovation acceptance behavior (Alam, Ali & Jani, 2011), this study adopted the IDT as the theoretical base to propose a MOTA system for new tourism cloud technology.

H1: An individual's IN has a direct and positive impact on PEOU with respect to MOTA.

H2: An individual's PEOU has a direct and positive impact on PUB with respect to MOTA.

H3: An individual's PUB has a direct and positive impact on BI with respect to MOTA.

H4: An individual's PEOU has a direct and positive impact on BI with respect to MOTA.

H5: An individual's IN has a direct and positive impact on BI with respect to ACMS.

H6: An individual's SN has a direct and positive impact on BI with respect to MOTA.

RESEARCH DESIGN

Data collection

The development of MOTA is still in promotional process in Taiwan; thus, the users who realize this new technology and adopt it are limited. Therefore, individuals from the public over 3 years old with experience in using MOTA were selected as the sample in this study.

Through the convenience sampling method, 52 people were chosen and asked to fill out the questionnaire. After excluding missing or incomplete data, the final valid questionnaire responses were obtained from 52 users, 53.8 percent of whom were male and 50 percent were aged 21–25 , and 28.8 percent were aged 16–20. Most of the respondents had college education (82.7percent)

Measures of the constructs

Based on the TAM (Davis, 1989; Davis et al., 1989), IDT (Rogers,1995), ,and MRT(Daft and Lengel,1986)–this study selected 26 constructs as the basis to develop the integrated acceptance model for MOTA. These constructs were PEOU, PUB, IN, SN, MRT, PE and BI. Their definitions and measures (see Table 2) are as follows. PEOU was used to present the user's perceived ease of use of MOTA and was evaluated by four measures (i.e., PEOU1~PEOU4). PUB was used to present the user's perceived usefulness of and benefits from MOTA and was evaluated by six measures (i.e., PUB1~PUB6). SN was used to present the user's perceived MOTA and was evaluated by four measures (i.e., SN1~SN4).

IN was used to present the user's innovativeness with respect to MOTA and was evaluated by three measures (i.e., IN1~IN3). MRT was used to present the user's media information with respect to MOTA and was evaluated by four measures (i.e., MRT1~MRT4). PE was used to present the user's perceived enjoyment from MOTA and was evaluated by three measures (i.e., PE1~PE3). Finally, BI was used to present the user's behavioral intention to use MOTA and was evaluated by three measures (i.e., BI1~BI3). For each measure, a five-point Likert scale was adopted, where the scores 1 to 5 were equivalent to "extremely disagree," "disagree,"

"neither agree nor disagree," "agree," and "extremely agree," respectively.

Data analysis methods

First of all, the confirmatory factor analysis (CFA) was used to examine the validity and reliability of the measurement models, and next the structural equation modeling (SEM) was employed to interpret the structural model, making use of LISREL 8.12 as the instrument for data analysis. Each of the impact coefficients was estimated using the maximum likelihood method, while the model's overall fit used the following indicators: chi-square statistic/degrees of freedom ($\chi 2/df$), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), parsimony goodness-of-fit index (PGFI), non-normalized fit index (NNFI), comparative fit index (CFI) and root mean square error of approximation (RMSEA)

RESULTS

Reliability and validity of the measurement model

This study used multiple items to present the latent constructs (i.e., PEOU, PUB, IN, SN, MRT, PE and BI) using a structured questionnaire. First, most of the goodness-of-fit indices suggested that the measurement model was a good fit to the data (see Table 1). Each latent construct was then tested for internal consistency using Cronbach's α and construct reliability. As shown in Table 2, the coefficients α ranged from 0.68 to 0.88, while the construct reliabilities ranged from 0.65 to 0.88. These indicated a higher internal consistency of measurement indicators; hence, the reliability of each construct was ensured (Nunnally, 1978; Bagozzi and Yi, 1988).

The convergent validity and discriminant validity were then assessed. Convergent validity is supported if the standardized factor loadings of the items on latent constructs are above 0.50 or are statistically significant (Bagozzi and Yi, 1988). In Table 2, the standardized factor loadings ranged from 0.60 to 0.86 and were statistically significant at $p<0.05$. Therefore, the convergent validity of the measurement indicators was supported. Discriminant validity test was performed to establish the distinction among the constructs used in this study. Thus, this study followed the method suggested by Hair et al. (2006) by pairing these two latent constructs and subjecting them to the two models of CFA. The first model allowed the correlation between the two constructs to be estimated (unconstrained), while in the other model, the correlation between the two constructs was set to 1 (constrained). The chi-square difference test was then used to compare the first model with the second model. The results

indicated that all of the chi-square difference values were statistically significant at $p<0.05$. Hence, the discriminant validity was supported.

Table1 Fit indices for measurement and structural model

Fit indices	Recommended value	Measurement model	Structural model
$\chi^2/d.f.$	≤ 3	1.34	1.49
GFI	≥ 0.9	0.64	0.61
AGFI	≥ 0.8	0.55	0.52
PGFI	≥ 0.5	0.51	0.50
NNFI	≥ 0.9	0.88	0.86
CFI	≥ 0.9	0.90	0.88
RMSEA	≤ 0.1	0.08	0.098

Table2 the results of CFA for measurement model (*N*=52)

Latent construct and items	Standardized factor loading	Construct reliability	Cronbach' α
Easy to use (PEOU)			
PEOU1: I think that the way using MOTA simple	0.81*	0.88	0.88
PEOU2: I think that the way using MOTA easily understandable and clear	0.79*		
PEOU3: I think that the way using MOTA easy to learn	0.86*		
PEOU4: As a whole, I think that the way using MOTA convenient to use	0.74*		
Perceived usefulness/benefit (PUB)			
PUB1:I think using MOTA can receive tourism information	0.65*	0.85	0.84
PUB2: I think using MOTA can prove tourism quality	0.63*		
PUB3: As a whole, I think MOTA is useful	0.75*		
PUB4: I think MOTA provide more information than others	0.71*		
PUB5: I think using MOTA is easier than others	0.80*		

Latent construct and items	Standardized factor loading	Construct reliability	Cronbach' α
PUB6:I think using MOTA is better than other for understanding Taipei city	0.60*		
(SN)			
SN1: relatives would recommend for using MOTA	0.71*	0.75	0.86
SN2: family would recommend for using MOTA	0.80*		
SN3: friend would recommend for using MOTA	0.60*		
(MRT)			
MRT1:MOTA gives custom using experience	0.65*	0.80	0.79
MRT2:MOTA provide a variety of travel information	0.79*		
MRT3: MOTA present travel information by variety ways	0.77*		
MRT4:I can get the information I need by using MOTA	0.60*		
PE			
PE1:using MOTA is a pleasure	0.80*	0.86	0.85
PE2:using MOTA is interesting	0.88*		
PE3: using MOTA maintain a good mood	0.78*		
Personal innovativeness (IN)			
IN1: I'm the first to try new technology among the surrounding people.	0.35*	0.65	0.68
IN2: I like to try new technology.	0.89*		
IN3: I'm open to new ideas.	0.57*		
Behavioral Intention (BI)			
BI1: If necessary, I would make use of MOTA often	0.62*	0.76	0.82
BI2: When I need, I am willing to use MOTA	0.85*		
BI3: As a whole, I am highly willing to use MOTA	0.68*		

Note: *: $p < 0.05$.

Structural model

The SEM technique was used to interpret the unified model (as illustrated in Figure 3). According to the analyzed results (see Table1), the overall fit indices of the model were all found to be within the acceptable scope, suggesting that the model was a good fit to the data.

It is obvious that there are only eight hypotheses that can be supported (see Table 3 and Figure 4): IN has a significantly positive impact on PEOU (λ = 0.71*); PEOU has a significantly positive impact on PUB (λ = 0.77*); PUB has a significantly positive impact on BI (λ = 0.42*); PEOU has a non-significant impact on BI (λ = 0.05); PI has a non-significant impact on BI(λ = -0.52); SN has a non-significant impact on BI (λ = 0.17);MRT has a non-significant impact on BI (λ = 0.12); and PE has a significantly Vpositive impact on BI (λ = 0.81*) In addition, the R^2 value of the unified model is 0.73 (> 0.5), showing that the unified model has good explanatory power.

Table3 summarizes the results of standard path coefficient for each hypothesis.

Hypothesis	Standard Path coefficient	Decision
H1:PI->PEOU	0.71*	Supported
H2:PEOU->PUB	0.77*	Supported
H3:PUB->BI	0.42*	Supported
H4:PEOU->BI	0.05(ns)	Not Supported
H5:PI->BI	-0.52(ns)	Not Supported
H6:SN->BI	0.17(ns)	Not Supported
H7:MRT->BI	0.12(ns)	Not Supported
H8:PE->BI	0.81*	Supported

Note: *: $p < 0.1$, **: $p < 0.05$, and ns: non-significant.

Furthermore, we analyzed the total effects of the factors on BI. The results indicated that the most critical factor that affects BI of MOTA is PE (0.81), followed by PUB (0.42), SN (0.17), MRT(0.12),PEOU (0.05) and PI(-0.52). Likewise, the effects of the other factors on BI are non-significant at $p < 0.05$.

Figure3 Proposed research model for tourist cloud service accept behavior system

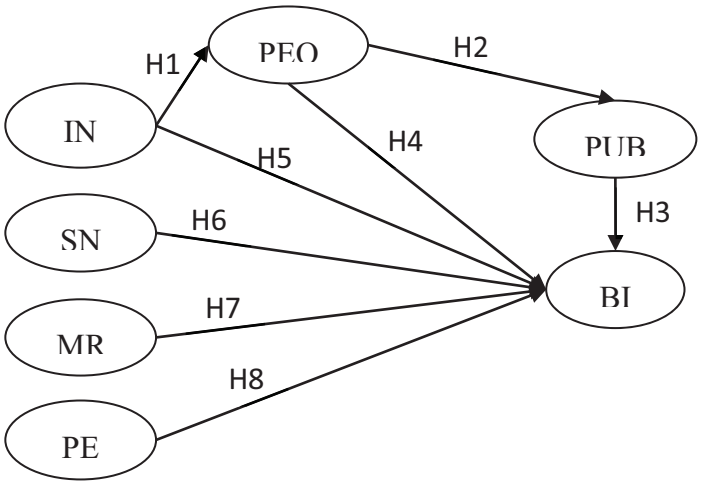
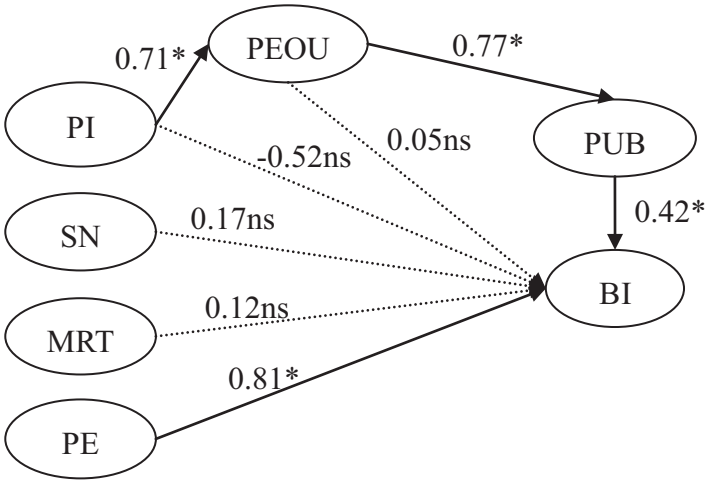


Figure4 MOTA for tourist cloud service accept behavior system



Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

HOW KNOWLEDGE INTEGRATION MECHANISMS AFFECT PRODUCT INNOVATION IN THE NPD PROCESS?

Teresa Tiaojung Hsu, Department of Business Administration, Cheng Shiu University
Email: teresa_hsu@hotmail.com
840, Chengcing Rd., Kaohsiung, 83347, Taiwan
Tel: +886-7-7310606 ext.5121; Fax: +886-7-7315367

Kuen-Hung Tsai, Department of Business Administration, National Taipei University
Email: atmas@mail.ntpu.edu.tw
151, University Rd., San Shia, Taipei 237, Taiwan
Tel: +886-2-86746568; Fax: 886-2-86715912

Yi-Chuan Liao, Department of Business Administration, National Taipei University
Email: obz703@gmail.com
151, University Rd., San Shia, Taipei 237, Taiwan
Tel: +886-2-86741111 ext.66553; Fax: 886-2-86715912

Corresponding author and presenter: Teresa Tiaojung Hsu

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

HOW KNOWLEDGE INTEGRATION MECHANISMS AFFECT PRODUCT INNOVATION IN THE NPD PROCESS?

Teresa Tiaojung Hsu, Department of Business Administration, Cheng Shiu University
Email: teresa_hsu@hotmail.com

Kuen-Hung Tsai, Department of Business Administration, National Taipei University
Email: atmas@mail.ntpu.edu.tw

Yi-Chuan Liao, Department of Business Administration, National Taipei University
Email: obz703@gmail.com

ABSTRACT

Purpose: *This study tries to examine how a company utilizes knowledge integration mechanisms (KIMs) to achieve the success of product innovation in a new product development (NPD) process.*

Research questions: *(1) How KIMs affect new product performance in the NPD process? (2) Is the effect of KIMs on performance different for developing products with different level of product advantage?*

Design: *This study forms a mediation model to examine that knowledge integration capability (KIC) mediates the effect of KIMs on new product performance, and then forms a moderated mediation model to examine the moderating effect of product advantage on this mediating relationship.*

Methodology: *The hierarchical regression is used to examine 128 Taiwan's manufacturing firms. This study follows Baron and Kenny's (1986) procedure to examine the mediation effect, and follows Muller, Judd, and Yzerbyt's (2005) steps to examine the moderated mediation effect.*

Findings: *KIC positively and completely mediates the effect of KIMs on new product performance. The mediating effect of KIC is strong when the level of product advantage is low.*

Research limitations: *This study only examines the relationship with a cross-sectional data. The generalizability of the findings is limited. This study merely examines product advantage as a moderator in the relationship.*

Research implications: *The use of KIMs is not a sufficient condition for product innovation but the integration capability is the key driver of product innovation. For developing product with*

less product advantage, the mediating effect of knowledge integration capability is stronger.
***Practical implications**: Although KIC converts the effect of KIMs on new product performance, but its effect varies as a function of product advantage. The view implies that by failing to consider the KIC's moderated-mediating role, managers may have reached an overly optimistic view on the effect of KIMs on product innovation.*

Keywords: knowledge integration mechanisms, knowledge integration capability, product advantage, new product performance

INTRODUCTION

Based on the knowledge-based theory, knowledge integration was viewed as the critical factor affecting firms' competitive advantage (Grant, 1996). To create competitive advantage, a firm must create new knowledge by exploring and exploit the acquired knowledge (Marsh and Stock, 2006; Teece, Pisano, and Shuen, 1997). Previous research suggests that the use of *knowledge integration mechanisms* (KIMs), which refer to the formal processes and structures that ensure the access and integration of knowledge among different functional units within a firm, is a critical factor that enables managers to internalize and reorganize what it has learned and decide how to use it in firm's new product development (NPD) process (Hamel and Prahalad, 1994; Zahra, Ireland, and Hitt, 2000). Even several studies have pursued extensively an understanding of the link between the use of KIMs and new product performance, how the effect of using KIMs on new product performance remains unclear. The interest in the assumed relationship between the use of KIMs and new product performance has shown apparent strategic importance in marketing literature. Moreover, previous study suggests that product innovation success appears to depend on the management's capability to effectively integrate all resources and utilize them to achieve success (Wells, 2008). Therefore, this study proposes that knowledge integration capability (KIC) is the key which leads the effect of KIMs to new product performance.

On the other hand, previous studies show that product advantage, which is considered a product's uniqueness and superiority relative to other products in the market (Atuahene-Gima, 1995; Langerak, Hultink, and Robben, 2004; Song and Parry, 1997), positively associates with product performance (Calantone, Chan, and Cui, 2006; Henard and Szymanski, 2001; Langerak et al., 2004). Some studies also indicate that product advantage is related to product newness (Kleinschmidt and Cooper, 1991), and product newness always represents a high uncertainty to firms. Other research suggests that the NPD process and its outcomes depend on the level of perceived uncertainty of the firm's decision makers regarding the external environment (Capon, Farley, Lehmann, and Hulbert, 1992; Zirger and Maidique, 1990). This study therefore tries to link the relationship to examine the moderating effect of product advantage in the KIMs-KIC-new product performance relationship.

LITERATURE REVIEW AND RESEARCH HYPOTHESES

Knowledge integration mechanisms

Some knowledge is tacit, making it difficult to use unless the knowledge integrates into the firm's operation (Grant, 1996). The task of knowledge integration is often accomplished by the use of structures and processes. Using the formal processes and structures ensures the access and integration of knowledge among different functional units within the firm (De Luca and Atuahene-Gima, 2007). Past literature suggests that the use of KIMs enables a firm to internalize and reorganize what it has learned and to decide on how to use the new knowledge (De Luca and Atuahene-Gima, 2007; Hamel and Prahalad, 1994). In order to utilize embedded knowledge that resides within individuals or social groups (Badaracco, 1991), firms need to integrate knowledge into the NPD process. During the integration process, managers must decide what knowledge should be accessed, evaluate the importance, and explore the way to reconfigure knowledge (Zahra et al., 2000). Firms that neglect knowledge integration processes may fail to achieve product innovation (De Luca and Atuahene-Gima, 2007).

Knowledge integration capability

Grant (1996) proposed that integration capability is a key to organizational survival in dynamic environments. Knowledge integration capability refers as a firm's ability to perform repeatedly a product task efficiently, extensively, and flexibly. Grant (1996) identified three characteristics of knowledge integration capability: efficiency of integration, scope of integration, and flexibility of integration. The efficiency of integration refers to the extent to which the capability accesses and utilizes the specialist knowledge held by individual organizational members. The scope of integration refers to the breadth of specialized knowledge the organizational capability draws upon. The flexibility of integration refers to the extent to which a capability can access additional knowledge and reconfigure existing knowledge.

The Mediating role of knowledge integration capability

Previous study identified the positive effect of KIMs on new product performance. However, how does KIMs affect new product performance remains unclear? The resource-based view literature emphasizes that the development of a capability for generating knowledge from external resource is based on internal processes and routines that are organizationally embedded in managerial interpretations (Sharma, 2000). The process of collecting and transferring knowledge among individuals characterizes with ambiguity, and then increasing the likelihood that firms will develop suitable KIMs (Birkinshaw, Nobel, and Ridderstråle, 2002; Germain and Dröge, 1997).

Previous research indicated that integration of primary activities usually results in greater efficiency (Barki and Pinsonneault, 2005) because integration saves time, reduces errors, facilitates the coordination of activities, and reduces total inventory cost (Malone et al., 1999). In addition, integration improves cross-functional communication and synergy, which led to a higher innovation rate and greater new product success (Cooper and Kleinschmidt, 1986). By

building on its existing knowledge, firms can build a broader understanding of market and technological requirements (Marsh and Stock, 2006). As relative capabilities change, firm boundaries are adjusted accordingly (Langlois, 1992). In NPD process, the increase in a firm's knowledge integration scope enhances the positive impact on its new product performance. For example, Hoegl, Ernst, and Proserpio (2007) indicated that as team member dispersion increases, the team work positively and significantly affects team performance. However, a flexible integration, either through continually integrating new tacit knowledge or through constantly reconfiguring existing knowledge, is likely to impose substantial costs in terms of reducing the efficiency of knowledge integration (Grant, 1996). This study argues that as the use of KIMs may increase the integration efficiency, scope, and flexibility of a firm's capability, thus increasing the success of new product performance. This study proposes:

H1: Knowledge integration capability positively mediates the relationship between knowledge integration mechanisms and new product performance.

Product advantage

In the NPD literature, product advantage is considered a product's uniqueness and superiority relative to other products in the market on dimensions such as quality, benefit, and function (Atuahene-Gima, 1995; Calantone et al., 2006; Langerak et al., 2004; Song and Parry, 1997). Highly innovative products are more differentiated from competitors' product in the market and have and greater product advantage (McNally, Cavusgil, and Calantone, 2010). A number of studies have confirmed a positive association between product advantage and performance (Calantone et al., 2006; Gatignon and Xuereb, 1997; Li and Calantone, 1998). A meta-analysis found that product advantage is the most potent driver to new product performance (Henard and Szymanski, 2001).

The Moderating role of product advantage

Product advantage is considered to be related to product newness (Kleinschmidt and Cooper, 1991). Highly innovative products are usually associated with novel attribute, and customers may be perceived more favorable to the new product. Owing to the novel attributes of new products, innovating products may face high uncertainty to firms in the NPD activity. Other research suggests that the NPD process and its outcomes depend on the level of perceived uncertainty of the firm's decision makers (Capon et al., 1992; Zirger and Maidique, 1990). Uncertainty is related to managerial perceptions of business environment that is unpredictable (Dess and Beard, 1984; Milliken, 1987). Highly uncertainty makes sales forecasts and market trends difficult to monitor or predict (Celly and Frazier, 1996). Information processing theory suggests the need of different types of integration mechanisms depends on levels of uncertainty and ambiguous (Sicotte and Langley, 2000). Therefore, businesses operating in an uncertain condition are likely to have a greater need to use KIMs in order to facilitate the flow of information.

The higher the uncertainty that makes internal information transfer more complex, the more need to integrate and centralize in the strategy decision. Therefore, high unpredictable environment

may encourage the firm to engage in dialogue within the firm in order to identify opportunities and facilitate new product development. Managers perceive environment uncertain when they have difficulty to predict the direction and viability of future technologies or to monitor the changing needs of consumers' preferences for product and services (Rueda-Manzanares, Aragón-Correa, and Sharma, 2008). Integration capability helps the firm to develop new knowledge and generate innovations (Sharma and Henriques, 2005). According to the resource-based view, firms obtain competitive advantage not only through the generation of unique, heterogeneous, tangible or intangible assets but also via their ability to integrate and develop these assets as capabilities to achieve new product success (Amit and Schoemaker, 1993; Barney, 1991). Therefore, this study proposes:

H2: The higher the advantage of a new product, the more positive the mediating effect of knowledge integration capability on the knowledge integration mechanisms-new product performance relationship.

RESEARCH METHODS

Measures

Most scales for the constructs included in this study are available in the extant literature: existing measures are used or adapted to suit the purposes of this study. However, scale for knowledge integration capability does not exist from previous study. This study develop knowledge integration capability scale based on Grant's (1996) conceptual definition. These items are pre-tested through interviews with both academic researcher and managers. At each stage, participants are required to comment on the ease with which they understand the items. Where items are confusing, they reword or eliminate in keeping with questionnaire development guideline (Churchill, 1979). After incorporating suggested changes, pilot test is conducted. Each measure is addressed as follows.

New product performance is measured using a five-item scale that is adapts and refines scale from De Luca and Atuahene-Gima (2007), Langerak, Hultink and Robben (2004). This study uses the scale to assess the extent to which the firm has achieved the product development objectives on market share, sales, profitability, sales growth, time-to-market, time to break-even, and within budget. *Knowledge integration mechanisms* are measured by a seven-item scale that is adapted from De Luca and Atuahene-Gima (2007). This study uses the scale to assess the extent to which a firm uses a set of formal processes to capture and integrate knowledge. This study develops *knowledge integration capability* scale based on Grant's (1996) conceptual definition. This study defines knowledge integration capability as the extent to which a firm's ability to perform repeatedly a product task efficiently, extensively, and flexibly. The efficiency of integration is defined as the extent to which a firm's ability to access and utilize the specialist knowledge held by individual organizational members. The scope of integration refers as the extent to which a firm's ability to collect different types of specialized knowledge. The flexibility of integration refers as the extent to which a firm's ability to extending existing knowledge to encompass additional type of knowledge and reconfiguring existing knowledge into new type of knowledge. Product advantage is measure using a seven-item scale adapted from Song and Parry

(1997), Langerak, Hultink, and Robben (2004), and Atuahene-Gima (1995). This scale assesses the extent to which a new product is highly innovative, is superior to competing product, and offers unique benefits for customers.

In addition to the above constructs, this study includes five control variables to reduce the possibility of alternative explanations, and to lend weight to the analyses in the next section. Firm size represents the degree to which a firm has plentiful resources (Bonner and Walker, 2004). Firms may be more able to innovate when they have greater resources (Autio, Sapienza, and Almeida, 2000). This study, as with previous studies (e.g., Atuahene-Gima, 2005; Tsai and Wang, 2008), employs the number of employees as a proxy for firm size. This study also controls the firm age variable because younger firms tend to be more flexible, while older firms may develop a more rigid bureaucratic structure and encounter a competency trap (Gopalakrishnan and Bierly, 2006; Tushman and Anderson, 1986). Besides, this study also controls three types of e*nvironmental context* adopted from Jaworski and Kohli (1993) which is composed of technological turbulence, market turbulence and competitive intensity. The technological turbulence is measured by a five-item scale that assesses the extent to which a firm perceived that a technology in an industry was in a state of flux. The market turbulence is measured by a seven-item scale that assesses the rate of change in the composition of customers and their preferences. Competitive intensity is measured by a six-item scale that assesses the behavior, resources, and their ability of competitors to differentiate product in the market. All variables are rated with Likert scales ranging from 1 (disagree extremely) to 7 (agree extremely).

Sample and data collection

The sample is drawn from Taiwan's manufacturing firms. Survey respondents were personnel from R&D, marketing, or manufacturing functional units that have been responsible for at least one NPD project launched within the three years prior to data collection in Taiwan. Collecting data at the project level was consistent with earlier research efforts (Souder et al., 1998). Accordingly, all measures were specified on the project level. Initially, each subject was contacted by telephone to verify qualification of having launching new product less than three year from the date and then to solicit cooperation in the study. Managers were promised, as an incentive, a summary of the research findings. A package was then mailed out consisting of a personalized letter on university headed paper, a copy of the questionnaire survey and a stamped return envelope. A reminder letter send out two weeks later and another letter and package to those who still had not responded three weeks later.

Survey respondents were personnel from R&D, marketing, or manufacturing functional units that have been responsible for at least one NPD project launched within the three years prior to data collection in Taiwan. The respondent was asked to complete the survey with respect to the product development process in which he or she had been involved. Before answering the questionnaire, we asked respondents to identify one new product launched by their firm within last three years among all product lines. This new product then served as a referent for all questions pertaining to the firm's product development process. Respondents then answer each question item according to their experience and judgment on whether they agree or disagree with the statements in the question items.

Reliability, Validity, and Descriptive Statistics

Reliability was initially evaluated using Cronbach's alpha and item-to-total correlations. This study uses confirmatory-factor analysis (CFA) to verify the reliability and validity of the scales. Except for technological turbulence construct, all the multi-item measures demonstrate adequate internal consistency, with all producing alphas of 0.70 or more threshold for acceptable reliability. These results indicate that the measures are internally consistent (Nunnally, 1978). The composite reliability (CR) of each scale was calculated using the procedures suggested by Fornell and Larcker (1981). The CR values for the constructs ranged from .61 to .94, exceeding the acceptable level of .60 suggested by Bagozzi and Yi (1988). As a further check, the major constructs of the values for average variance extracted (AVE) exceeded the threshold level of .50 suggested by Bagozzi, Yi, and Phillips (1991). The significance of each standardized coefficient loading indicates convergent validity (Bagozzi et al., 1991). The CFA results show that each of the measures loaded significantly on its intended construct, indicating convergent validity in each scale. The square roots of the AVE for each construct are significantly greater than the off-diagonal elements (Hulland, 1999), meeting Fornell and Larcker's (1981) criterion for discriminant validity. The model shows that a comparative fit index (CFI) of 0.94, incremental fit (IFI) of 0.94, non-normed fit (NNFI) of 0.93, and the root mean square error of approximation (RMSEA) of 0.078, suggesting an acceptable degree of model fit. Table 1 shows the means, standard deviation, correlation, and square roots of average variances extracted in this study.

RESULTS

This study evaluates the proposed models using the Baron and Kenny's (1986) procedure to examine the mediation and using Muller, Judd, and Yzerbyt (2005) approach to examine the moderated mediation. Since the product term is usually highly correlated with its individual variable, the model estimations follow the straightforward procedure suggested by Friedrich (1982) to reduce or eliminate multicollinearity bias. Table 1 shows the result of mediation and Table 2 summarize the statistical results of moderated mediation.

TABLE 1 Mean, standard deviation, correlation, and square roots of average variances extracted

Variable	1	2	3	4	5	6	7	8	9
(1) New product performance	**.85**								
(2) KIMs	.39	**.81**							
(3) KIC	.42	.69	**.77**						
(4) Product advantage	.25	.41	.44	**.75**					
(5) Market turbulence	.42	.30	.41	.49	**.63**				
(6) Competitive intensity	.23	.14	.17	-.00	.44	**.65**			
(7) Technological	.30	.39	.25	.46	.52	.40	**.54**		
(8) Company Age	-.02	.01	.08	.06	.12	-.10	.00	N.A.	
(9) Company Size	.13	.04	-.03	-.28	-.11	-.08	-.09	.34	N.A.
Number of items	5	7	11	7	6	5	4	1	1
Mean	4.51	5.16	4.99	5.04	5.12	5.16	5.31	5.23	4.60
SD	1.20	1.13	1.03	1.09	.85	1.09	.87	2.07	1.73

Note: * The notations are interpreted as below, and used in the rest of this study: KIMs: knowledge integration mechanisms. KIC: knowledge integration capability. N.A. = not applicable.

** Square roots of average variances extracted are bold on the diagonal. The figures on the triangle elements are correlations among the composite measures (unweighted mean of the items for each construct).

In Table 1, the result in model 2 show that the coefficient estimate of KIMs is significant, indicating that KIMs has a positive effect on KIC. Furthermore, the results in Model 3 show that the effect of KIC on new product performance is significant and that the coefficient estimate of KIMs on new product performance is significantly reduced from Model 1. This results support H1, suggesting that KIC totally mediates the positive effect of KIMs on new product performance.

TABLE 2 Results of regression analysis for mediation

	Criterion: KIC		Criterion: NPP			
	Model 2		Model 1		Model 3	
Independent Variables	**b**	***t***	**b**	***t***	**b**	***t***
Firm age	.03	*(.86)*	-.06	*(-1.54)*	-.07	*(-1.73)*
Firm size	-.03	*(-.79)*	.12	*(2.51)*	.13	*(2.67)* **
Market turbulence	.33	*(3.54)* ***	.42	*(3.69)*	.35	*(2.96)* **
Competitive Intensity	.02	*(.29)*	.03	*(.34)*	.02	*(.29)*
Technology turbulence	-.19	*(-2.13* *)*	.02	*(.14)*	.06	*(.51)*
KIMs	.67	*(9.79)* ***	.27	*(3.23)* ***	.13	*(1.16)*
KIC					.21	*(1.93)* *
F value	23.43 ***		8.45 ***		7.94 ***	
R^2	.54		.30		.32	
Adjusted R^2	.52		.26		.28	
ΔR^2	.37		.06		.02	
F change	95.78 ***		10.43 **		3.73	

*p < .05; **p < .01; ***p < .001 (one-tailed test for hypotheses, and two-tailed test for control variables).

Notes: N = 128. b = standardized path coefficients. *t* = t value. NPP = new product performance. KIMs = knowledge integration mechanisms. KIC = knowledge integration capability.

In Table 2, the results from Model 1 indicate an overall effect of KIMs on new product performance (β_{16} = .26, p < .01), but that of the product term of KIMs and product advantage does not achieve a statistical significance (β_{18} = .01, p > .05). This satisfies the necessary condition required for a moderated mediation examination. Next, Model 2 presents a significant coefficient estimate of KIMs (β_{26} = .62, p < .01), Model 3 indicates that the coefficient estimate of the KIC × product advantage interaction is significant (β_{26} = -.21, p < .05). Taking these statistical results together, the results support H2, suggesting that KIC have a mediating effect on the link between KIM and new product performance and that this mediating effect is affected by product advantage. Previous research suggests that merely inspecting the signs and magnitudes of regression coefficients is usually insufficient for a moderation (contingency) hypothesis (Schoonhoven, 1981). Hence, this study further performed post hoc analysis to examine the nature of this interaction using the Aiken and West (1991) procedure. Results of post hoc analysis reveal that the mediating effect of KIMs is stronger when product advantage is low (β= .27, *p* < .01). In contrast, when product advantage is high, the mediating effect of KIMs remains the

same (β= -.01, p > .05).

DISCUSSION

Summary

This paper seeks to advance the marketing and innovation management literature by untangling the relationships among KIMs, KIC, product advantage, and new product performance. The results show that KIC completely mediates the relationship between KIMs and new product performance, and this mediating effect is strong when the level of product advantage is low.

Contributions to Scholarship

This research contributes to extant literature in the following ways. First, previous study suggested that new product performance is enhanced by KIMs (De Luca and Atuahene-Gima, 2007; Ruekert and Walker, 1987); this study deepens the current literature by providing a completely mediating factor of knowledge integration capability which leads the effect of KIMs to reach new product success. In other words, the success of knowledge integration can be attributed to the increase in integration capability. Second, this study further demonstrates that such an effect varies with the level of product advantage. The findings of this study show that KIC play an important role for utilizing KIMs in the NPD process to achieve new product performance, and further show that when product advantage is low, a product's uniqueness and superiority relative to other products in the market is not particularly obvious; firms utilizing integration mechanisms in the NPD process possess high integration capability of innovating product, thus producing higher innovation performance. On the contrary, when product advantage is high, the mediating effect of knowledge integration capability remains the same. These findings imply that for it is especially important to fertilize the integration capability for developing less innovative product.

Applied contributions

The finding of this study demonstrates that it is not integration mechanisms itself but integration capability to achieve new product success in a NPD process. It indicates that the use of KIMs is not a sufficient condition for product innovation but the integration capability is the key driver of product innovation. Managers who encourage the use of KIMs but do not focus on the increase of integration capability will not achieve new product success. In the other way, the finding of this study show the mediating effect of knowledge integration capability is especially useful for products with less superiority to other product in the market in the NPD activity. For those firm developing less innovative products, managers should deliberate the use of KIMs to make progress on integration capability to achieve new product success.

Limitations and future research directions

This study attempts to discover some fundamental ideas among knowledge integration mechanisms, knowledge integration capability, product advantage, and new product performance.

However, any conclusions drawn from this study should be viewed in the context of its limitations, and should also be extended in future studies. The results of this study have three main limitations that also offer opportunities for further research. First, this study examines the relationships with a cross-sectional data. The results of this study may not accurately portray firms' long-term product performance. Future study may use a longitudinal research design and assess actual performance with the data from company records. Second, the generalizability of these findings is limited because these findings are based on a sample of Taiwanese manufacturing firms. Future study should be validated in detail in other contexts. Third, this study merely examines product advantage as a moderator in the stated relationship; however, there are other possible moderators affecting the relationship.

REFERENCES

1. Aiken, L. S. and West, S. G. (1991), *Multiple regression: Testing and interpreting interactions*, Sage Publications, Newbury Park, CA.
2. Amit, R. and Schoemaker, P. J. H. (1993), "Strategic assets and organizational rent." *Strategic Management Journal*, Vol. 14, No. 1, pp.33-46.
3. Atuahene-Gima, K. (1995), "An exploratory analysis of the impact of market orientation on new product performance: A contingency approach." *Journal of Product Innovation Management*, Vol. 12, No. 4, pp.275-293.
4. Atuahene-Gima, K. (2005), "Resolving the capability–rigidity paradox in new product innovation." *Journal of Marketing*, Vol. 69, No. 4, pp.61-83.
5. Autio, E., Sapienza, H. J., and Almeida, J. G. (2000), "Effects of age at entry, knowledge intensity, and imitability on international growth." *Academy of Management Journal*, Vol. 43, No. 5, pp.909-924.
6. Badaracco, J. L. (1991), *The knowledge link*, Harvard Business School Press, Boston.
7. Bagozzi, R. P. and Yi, Y. (1988), "On the evaluation of structural equation models." *Journal of the Academy of Marketing Science*, Vol. 16, No. 1, pp.74-94.
8. Bagozzi, R. P., Yi, Y., and Phillips, L. W. (1991), "Assessing construct validity in organizational research." *Administrative Science Quarterly*, Vol. 36, No. 3, pp.421-458.
9. Barki, H. and Pinsonneault, A. (2005), "A model of organizational integration, implementation effort, and performance." *Organization Science*, Vol. 16, No. 2, pp.165-179.
10. Barney, J. (1991), "Firm resources and sustained competitive advantage." *Journal of Management*, Vol. 17, No. 1, pp.99-120.
11. Baron, R. M. and Kenny, D. A. (1986), "The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations." *Journal of Personality and Social Psychology*, Vol. 51, No. 6, pp.1173-1182.
12. Birkinshaw, J., Nobel, R., and Ridderstråle, J. (2002), "Knowledge as a contingency variable: Do the characteristics of knowledge predict organization structure?" *Organization Science*, Vol. 13, No. 3, pp.274-289.
13. Bonner, J. M. and Walker, O. C. (2004), "Selecting influential business-to-business customers in new product development: Relational embeddedness and knowledge heterogeneity considerations." *Journal of Product Innovation Management*, Vol. 21, No. 3, pp.155-169.
14. Calantone, R. J., Chan, K., and Cui, A. S. (2006), "Decomposing product innovativeness and

its effects on new product success." *Journal of Product Innovation Management*, Vol. 23, No. 5, pp.408-421.
15. Capon, N., Farley, J. U., Lehmann, D. R., and Hulbert, J. M. (1992), "Profiles of product innovators among large U.S. Manufacturers." *Management Science*, Vol. 38, No. 2, pp.157-169.
16. Celly, K. S. and Frazier, G. L. (1996), "Outcome-based and behavior-based coordination efforts in channel relationships." *Journal of Marketing Research*, Vol. 33, No. 2, pp.200-210.
17. Churchill, G. A. (1979), "A paradigm for developing better measures of marketing constructs." *Journal of Marketing Research*, Vol. 16, No. 1, pp.64-73.
18. Cooper, R. G. and Kleinschmidt, E. J. (1986), "An investigation into the new product process: Steps, deficiencies, and impact." *Journal of Product Innovation Management*, Vol. 3, No. 2, pp.71-85.
19. De Luca, L. M. and Atuahene-Gima, K. (2007), "Market knowledge dimensions and cross-functional collaboration: Examining the different routes to product innovation performance." *Journal of Marketing*, Vol. 71, No. 1, pp.95-112.
20. Dess, G. G. and Beard, D. W. (1984), "Dimensions of organizational task environments." *Administrative Science Quarterly*, Vol. 29, No. 1, pp.52-73.
21. Fornell, C. and Larcker, D. F. (1981), "Evaluating structural equation models with unobservable variables and measurement error." *Journal of Marketing Research*, Vol. 18, No. 1, pp.39-50.
22. Friedrich, R. J. (1982), "In defense of multiplicative terms in multiple regression equations." *American Journal of Political Science*, Vol. 26, No. 4, pp.797-833.
23. Gatignon, H. and Xuereb, J.-M. (1997), "Strategic orientation of the firm and new product performance." *Journal of Marketing Research*, Vol. 34, No. 1, pp.77-90.
24. Germain, R. and Dröge, C. (1997), "Effect of just-in-time purchasing relationships on organizational design, purchasing department configuration, and firm performance." *Industrial Marketing Management*, Vol. 26, No. 2, pp.115-125.
25. Gopalakrishnan, S. and Bierly, I. P. E. (2006), "The impact of firm size and age on knowledge strategies during product development: A study of the drug delivery industry." *IEEE Transactions on Engineering Management*, Vol. 53, No. 1, pp.3-16.
26. Grant, R. M. (1996), "Prospering in dynamically-competitive environments: Organizational capability as knowledge integration." *Organization Science*, Vol. 7, No. 4, pp.375-387.
27. Hamel, G. and Prahalad, C. K. (1994), *Competing for the future*, Harvard Business School Press, Boston.
28. Henard, D. H. and Szymanski, D. M. (2001), "Why some new products are more successful than others." *Journal of Marketing Research*, Vol. 38, No. 3, pp.362-375.
29. Hoegl, M., Ernst, H., and Proserpio, L. (2007), "How teamwork matters more as team member dispersion increases." *Journal of Product Innovation Management*, Vol. 24, No. 2, pp.156-165.
30. Hulland, J. (1999), "Use of partial least squares (PLS) in strategic management research: A review of four recent studies." *Strategic Management Journal*, Vol. 20, No. 2, pp.195-202.
31. Jaworski, B. J. and Kohli, A. K. (1993), "Market orientation: Antecedents and consequences." *Journal of Marketing*, Vol. 57, No. 3, pp.53-70.
32. Kleinschmidt, E. J. and Cooper, R. G. (1991), "The impact of product innovativeness on performance." *Journal of Product Innovation Management*, Vol. 8, No. 4, pp.240-251.

33. Langerak, F., Hultink, E. J., and Robben, H. S. (2004), "The impact of market orientation, product advantage, and launch proficiency on new product performance and organizational performance." *Journal of Product Innovation Management*, Vol. 21, No. 2, pp.79-94.
34. Langlois, R. N. (1992), "Transaction-cost economics in real time." *Industrial and Corporate Change*, Vol. 1, No. 1, pp.99-127.
35. Li, T. and Calantone, R. J. (1998), "The impact of market knowledge competence on new product advantage: Conceptualization and empirical examination." *Journal of Marketing*, Vol. 62, No. 4, pp.13-29.
36. Malone, T. W., Crowston, K., Lee, J., Pentland, B., Dellarocas, C., Wyner, G., Quimby, J., Osborn, C. S., Bernstein, A., Herman, G., Klein, M., and O'Donnell, E. (1999), "Tools for inventing organizations: Toward a handbook of organizational processes." *Management Science*, Vol. 45, No. 3, pp.425-443.
37. Marsh, S. J. and Stock, G. N. (2006), "Creating dynamic capability: The role of intertemporal integration, knowledge retention, and interpretation." *Journal of Product Innovation Management*, Vol. 23, No. 5, pp.422-436.
38. McNally, R. C., Cavusgil, E., and Calantone, R. J. (2010), "Product innovativeness dimensions and their relationships with product advantage, product financial performance, and project protocol." *Journal of Product Innovation Management*, Vol. 27, No. 7, pp.991-1006.
39. Milliken, F. J. (1987), "Three types of perceived uncertainty about the environment: State, effect, and response uncertainty." *Academy of Management Review*, Vol. 12, No. 1, pp.133-143.
40. Muller, D., Judd, C., and Yzerbyt, V. (2005), "When moderation is mediated and mediation is moderated." *Journal of Personality & Social Psychology*, Vol. 89, No. 6, pp.852-863.
41. Nunnally, J. C. (1978), *Psychometric theory, 2nd ed.*, Mcgraw Hill, N.Y.
42. Rueda-Manzanares, A., Aragón-Correa, J. A., and Sharma, S. (2008), "The influence of stakeholders on the environmental strategy of service firms: The moderating effects of complexity, uncertainty and munificence." *British Journal of Management*, Vol. 19, No. 2, pp.185-203.
43. Ruekert, R. W. and Walker, O. C. (1987), "Marketing's interaction with other functional units: A conceptual framework and empirical evidence." *Journal of Marketing*, Vol. 51, No. 1, pp.1-19.
44. Schoonhoven, C. B. (1981), "Problems with contingency theory: Testing assumptions hidden within the language of contingency "theory"." *Administrative Science Quarterly*, Vol. 26, No. 3, pp.349-377.
45. Sharma, S. (2000), "Managerial interpretations and organizational context as predictors of corporate choice of environmental strategy." *Academy of Management Journal*, Vol. 43, No. 4, pp.681-697.
46. Sharma, S. and Henriques, I. (2005), "Stakeholder influences on sustainability practices in the Canadian forest products industry." *Strategic Management Journal*, Vol. 26, No. 2, pp.159-180.
47. Sicotte, H. and Langley, A. (2000), "Integration mechanisms and r&d project performance." *Journal of Engineering & Technology Management*, Vol. 17, No. 1, pp.1-37.
48. Song, M. and Parry, M. (1997), "The determinants of Japanese new product successes." *Journal of Marketing Research*, Vol. 34, No. 1, pp.64-76.

49. Teece, D. J., Pisano, G., and Shuen, A. (1997), "Dynamic capabilities and strategic management " *Strategic Management Journal*, Vol. 18, No. 7, pp.509-533.
50. Tsai, K.-H. and Wang, J.-C. (2008), "External technology acquisition and firm performance: A longitudinal study." *Journal of Business Venturing*, Vol. 23, No. 1, pp.91-112.
51. Tushman, M. L. and Anderson, P. (1986), "Technological discontinuities and organizational environments." *Administrative Science Quarterly*, Vol. 31, No. 3, pp.439-465.
52. Wells, R. M. J. (2008), "The product innovation process: Are managing information flows and cross-functional collaboration key?" *Academy of Management Perspectives*, Vol. 22, No. 1, pp.58-60.
53. Zahra, S. A., Ireland, R. D., and Hitt, M. A. (2000), "International expansion by new venture firms: International diversity, mode of market entry, technological learning, and performance." *Academy of Management Journal*, Vol. 43, No. 5, pp.925-950.
54. Zirger, B. J. and Maidique, M. A. (1990), "A model of new product development: An empirical test." *Management Science*, Vol. 36, No. 7, pp.867-883.

TABLE 3 Results of regression analysis for moderated mediation

	Criterion: KIMs		Criterion: NPP			
	Model 2		Model 1		Model 3	
Independent Variables	**b**	***t***	**b**	***t***	**b**	***t***
Firm age	.03	*(.79)*	-.07	*(-1.57)*	-.06	*(-1.44)*
Firm size	-.00	*(-.06)*	.13	*(2.49)* *	.13	*(2.53)* *
Market turbulence	.25	*(2.56)* *	.40	*(3.20)* ***	.33	*(2.67)* **
Competitive Intensity	.07	*(1.05)*	.04	*(.47)*	.02	*(.25)*
Technology turbulence	-.25	*(-2.66)* **	.00	*(-.00)*	.07	*(.59)*
KIMs	.62	*(8.79)* ***	.26	*(2.93)* **	.12	*(1.11)*
Product advantage	.18	*(2.04)* *	.05	*(.43)*	.03	*(.26)*
KIMs x Product advantage	-.04	*(.64)*	.01	*(.18)*	.15	*(1.47)*
KIC					.20	*(1.81)* *
KIC x Product advantage					-.21	*(-1.89)* *
F value	18.48 ***		6.27 **		5.95 ***	
R^2	.55		.30		.34	
Adjusted R^2	.52		.25		.28	
ΔR^2	.00		.00		.04	
F change	.43		.03		3.59	

*p < .05; **p < .01; ***p < .001 (one-tailed test for hypotheses, and two-tailed test for control variables).

Notes: N = 128. b = standardized path coefficients. *t* = t value. NPP = new product performance. KIMs = knowledge integration mechanisms. KIC = knowledge integration capability.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

BUSINESS CASE ANALYSIS FOR RAPID PRODUCTISATION

Tuomo Kinnunen, University of Oulu, Finland
tuomo.kinnunen@oulu.fi

Kai Hänninen, University of Oulu, Finland
kai.hanninen@oulu.fi

Harri Haapasalo, University of Oulu, Finland
harri.haapasalo@oulu.fi

Hanna Kropsu-Vehkaperä, University of Oulu, Finland
hanna.kropsu-vehkapera@oulu.fi

ABSTRACT

Purpose *The objective of this study is to construct the procedure of business case analysis for rapid productisation. The paper studies the practice of business case analysis to aid collaborative decision making between product management and sales management.*
Design/Methodology *The research is qualitative and constructive in nature. We studied relevant literature and conducted an exploratory case study. Primary data was collected by semi-structured interviews. Business case analysis procedure for rapid productisation is constructed based on the literature study and the interview data analysis.*
Findings *A state of the art practice of analysing rapid productisation opportunities is described. Such an analysis includes estimating and calculating revenue and costs, and checking strategic fit. Especially it includes considering the importance of the customer and the sales case in the revenue side, and project cost and resource reallocation cost. In addition, cost structure and market potential are estimated for the items that decided to include into global portfolio.*
Originality/Value *This study provides insight of the co-operation between sales, R&D and product management in building business case for rapid productisation. The results of the study are applicable for benchmarking similar industrial practices. The study contributes to the research of order delivery process and new product development in the area of rapid productisation.*

Keywords: Business case analysis, productisation, rapid productisation

INTRODUCTION

To succeed in competition, companies need to offer products and services which meet the diverse needs of customers and market (Ulrich and Eppinger, 2008; Henard and Slymanski, 2001). An efficient way to provide wide product portfolio is mass customisation, which relies heavily on configurable and modular products (Hvam et al., 2008; Kratochvi´l and Carson, 2005). However, needs may evolve and new opportunities rise after products are launched. In case of modular product structure, companies could respond by changing or redesigning product modules on the fly. The context of this study is limited to the process of introducing

that kind of changes in existing products to serve sales and order-delivery process. The focus of the study is in business case analysis for such rapid productisation.

Business case analysis is common practice for analysing and defining potential investments (Keen and Digrius, 2002; Randall et al., 2012). Its main goal is to demonstrate, in a rational way, the true business value of potential investment. According Keen and Digrius (2002) business case analysis describes business reasons why or why not specific investment options should be selected. Ultimately, productisation is driven by intent to create successful products and profitable business. The same drivers must be employed in business case analysis for productisation (Kinnunen et al., 2011).

Rapid productisation is widely utilised industrial practice especially in business to business companies. Typically, managers describe rapid productisation as an ad-hoc procedure which may disturb other business processes but is necessary for satisfying a customer and getting a new order. Compared to incremental product development (e.g. Gautam and Singh, 2008), rapid productisation as a customer-initiated and sales-driven process comes up unexpectedly, necessitates fast reaction and decision-making, and may not necessarily settle on the product portfolio. The more systematic procedure for rapid productisation could provide benefits and even competitive advantage for some companies (Hanninen et al., 2013). Literature does not recognise any holistic framework to recognise and analyse opportunities of rapid productisation. This clearly indicates a gap between literature and practice.

The aim of this study is to construct a framework and procedure of business case analysis for rapid productisation. The aim is divided to two research questions:

RQ1: *How does business case analysis for rapid productisation differ from the analysis for new product development?*

RQ2: *How should business case be constructed in rapid productisation?*

To fill the gap in literature the research questions will be answered by an exploratory case study. At first, relevant literature was studied in the fields of productisation and business case analysis to synthesise the theoretical frame for the study. Then, the case study was designed and primary data was collected by interviewing industrial experts involved and interested on this area. Then the data was analysed and the findings were discussed. Finally, we conclude the study by summarising the main results and findings. In our study, literature creates the framework but research questions are finally answered through empirical data.

LITERATURE STUDY

In a simplified matter, each product goes through two types of processes during its lifecycle; the product process and the order-delivery process. The product process includes new product introduction, product development, product maintenance and marketing processes while the order-delivery process consists of five phases: sales, procurement, manufacturing, delivery and service or maintenance (Saaksvuori and Immonen, 2008). The product process, the product creation process and the new product development process are concerned as synonyms with the productisation process in this study. Productisation is understood as a commercial function by which a company creates and updates its offering to respond a market opportunity and need. While the essence of any product is to satisfy customer needs or solve a customer problem, the purpose of productisation emphasise creating a tangible,

repeatable offering which is efficient to produce and deliver and easy to sell, buy and use (Hietala, 2004; Simula, 2008).

The concept of rapid productisation is not yet well established in literature. Thus the definition of rapid productisation requires critical examination from two different process viewpoints. At first, the productisation process defines, designs and develops new products to the product portfolio (Ulrich and Eppinger, 2008). Secondly, the order-delivery process which defines how individual products are sold, manufactured and delivered to the customer, and maintained after sales (Chung et al., 2007; Saaksvuori and Immonen, 2008). Within this viewpoint, it may be beneficial discuss about stock and delivery items instead of products in general.

Business case analysis in new product development

New product development (NPD) is a key process for companies in seeking business success. Strong business-orientation is very apparent in NPD literature for example through gate criteria (Carbonell-Foulquie et al., 2004; Hart et al., 2003; Ronkainen ,1985). Typically, the starting phase of an NPD process is employed to both screen out the ideas with weak business potential and prioritise ideas with strong business potential. For example, Cooper (2001, 2007) describes the first NPD phase as scoping which contains preliminary market, technical and financial assessment as well as a rudimentary quick check of the business rationale and financial prospects of the project. Similar issues may be checked preceding the formal NPD process. Koen et al. (2001) proposes business case development during front end of innovation based on estimates of market potential, customer needs, investment requirements, competitor assessments, technology unknowns and overall project risk.

Business case is prepared during early phases of NPD to aid decision-making whether to invest resources for a development project (Otto and Wood, 2001). According Cooper (2001) the business case has three main components:

1) *Product and project definition*. Whom the product will be targeted at and what the product will be? Define benefits, features, and design requirements of the product.
2) *Product justification.* Why should a company invest in a project? It includes a review of financial, profitability and risk considerations. Also nonfinancial considerations, such as strategic rationale, competitive advantage, leverage and market attractiveness, should be included.
3) *Project plan*. How and by whom the path from development to launch is taken? It may be formulated as a critical path plan including schedule, the launch date and required resources – money, people, and equipment.

An important precondition for business case analysis is the existence of past financial information or analogous product data. Otherwise, the data must be extrapolated from a similar or analogous product, or rough estimates of product layouts. The cost data must be established considering the marketplace: e.g. unit costs and sales volume curves, dependence on other products or systems of the customers. (Otto and Wood, 2001).

Business case analysis in new product development may be too laborious and extensive to be used in rapid productisation. All the required data for different business case elements, namely market assessment, technical assessment, strategic fit and financial analysis, might

not be available or not relevant (Kinnunen et al., 2011). For example, rapid productisation does not include thorough technical assessment because totally new technologies are too risky to productise rapidly, uncertainties must be manageable and technical solution must be defined quickly. Market assessment for rapid productisation is more sales-driven excluding a thorough market study. However, customer value may be evaluated similarly, and potentially market assessment provides similar outcome data. Strategic fit must be straight-forward to check quickly in case of rapid productisation. Finally, financial analysis is quite similar in both cases since it includes calculating and synthesising financial value into few key business performance indicators, such as return of investment (ROI) and net profit.

Instead of NPD business case analysis, rapid productisation business case analysis may be more similar to business consideration during the front end or the very first phase of NPD process. E.g. Cooper (2001) defines that as scoping phase which includes issues such as to check any market prospects, potential and requirements; technical feasibility, solutions and risks. Still, NPD literature does not provide any means to analyse a sales case or evaluate an order from either a customer or a company viewpoint.

Order delivery process and rapid productisation

Companies' current customer order point (COP) and order delivery process set the context for rapid productisation (Hvam et al., 2008). Rapid productisation does not fit all kind of delivery modes. In case of engineer-to-order delivery mode, all delivered products are productised or tailored for customers and rapid productisation is not a necessary option. In contrary, the make-to-stock delivery mode focus on efficient operations with existing stock items excluding any new specifications for orders (Chung et al., 2007). Thus rapid productisation is not a meaningful option for companies which current delivery mode is make-to-stock. Nevertheless, rapid productisation fits for the companies that have adopted modular product structure and use the configure-to-order delivery mode. In that mode products are built from standard parts and modules, and possible variants are specified by a configurator according predefined configuration rules (Hvam et al., 2011). If available configurations do not satisfy customer rapid productisation can be initiated to redesign or change existing modules to meet customer needs. In addition to productisation challenges this is an exception case for sales and current order-delivery process.

From order delivery process viewpoint, rapid productisation cases could be processed by order partitioning and hybrid mode of product delivery (Rafiei and Rabbani, 2011) or by bringing forward the customer order point (COP) from the current mode of delivery, e.g. from variant selection to configure to order (e.g. Hvam et al., 2008) Each order which include rapid productisation increases product variety from the order delivery viewpoint. Increased variety may be necessary to keep customers satisfied and to increase sales. However, it may disturb the normal order delivery process and include hidden costs related to the process. Thus, complete picture of the costs and benefits of variety should be known to assess the true profitability of rapid productisation (Ward et al., 2010) An example of case evaluation including order delivery process issues, namely variety cost-benefit calculator, is described by Ward et al. (2010).

METHODOLOGY

This research is a qualitative case study in nature. The study applies an explorative and constructive research approach. The research process is illustrated in figure 1.

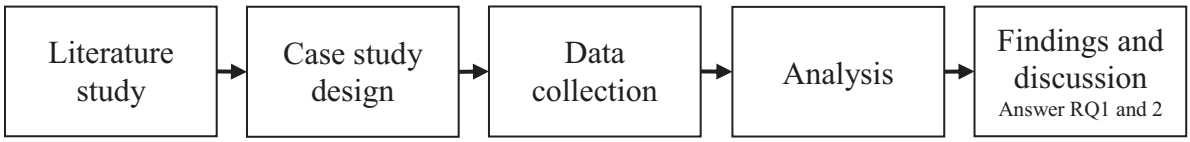


Figure 1. The research process

Case study design included creating a semi-structured interview questionnaire. The questionnaire was sent in advance to the interviewees to aid their preparing. The data was gathered through semi-structured interviews. Seven highly-experienced business managers engaged to rapid productisation were interviewed in six different companies. Interviews were recorded and transcribed to ensure thorough analysis. The transcriptions and interview summaries were sent to the interviewees to correct any misunderstandings. The interview data was collected during August 2011. In addition to the interview data and literature study, also secondary data was collected including business case documentations in two companies, discussions with experts and meeting minutes.

The interview data was analysed to provide a picture on rapid productisation business case in general and piece-by-piece as perceived by company managers. The secondary data sources were used to enhance understanding, support analysis and validate findings.

RESULTS AND ANALYSIS

The results are described by presenting relevant excerpts from the interview data. Table 1. provides managerial perceptions on business case in general and go through in a more detailed way one of the key issues of any business case that is named as profitability analysis.

Table 1. Managers' perceptions on business case and profitability analysis

Issue	Excerpts from interview data
Perceptions on business case	A) *"It is a document" – " Combined with an offer business case indicates an acceptable price"* B) *"Business case becomes after calculating monetary value. Otherwise it is a mere case."* *"It is an analysed and documented team effort to aid managerial decision making"* C) *"Business case is a payback plan." – "Business case is done for the company in collaboration between a product manager and a sales representative. Sales intend to make a deal and their task is to calculate break-even point of a sales case. Product managers intend to create a commercial product and their task is to consider business case for the solution.* D) *"Business case consists of two sections: sales plan and cost plan. Sales plan includes product sales during its predicted lifecycle and impact on sales of other products. Cost plan includes costs "* E) *"It is a justification for why to initiate a case. They are used for prioritisations."*
Profitability analysis	A) *" As a part of price determination, profitability is a type of NPV (net present value) calculation " – "A customer variant is not always profitable. It may be necessary to make it in order to win a big deal where the benefit comes standard blocks."* B) *"Profitability assessment depends on the size of the project and the customer." – "Calculation can be based an internal price compared to the invoiced price and related costs."* C) *"For customer variant requests we have a good formula for calculating cost of changes and implementation lead time." – "Finance and Control organisation provides manufacturing cost and total cost of products." – "In negotiations the profitability is calculated quite efficiently by Sales Simulation system which collects fact-based information from different places."* D) *"Globally defined, cost-based transfer prices are the starting point for pricing by a sales team."* *"Depending on the state of negotiations, certain products may take a loss and certain products may make profit in the same deal. Finding out the profitability of an individual deal, sales item or product in the global business may be challenging."* E) *In that case, a sales representative assesses whether marginal income is adequate. Typically it is very short profitability analysis focusing only to the project in hand."* F) *"It is a pretty basic business thing to consider the expenses and income."*

Managers perceive business case as

- being a document and justification for the case
- aiding decision-making
- including essentially calculation of monetary value

The perceptions on business case are quite consistent with our findings from literature. Instead, profitability analysis seems to vary more from a company to other. This may illustrate the fact that rapid productisation concerns different kind of changes in different products. An interesting point is the co-operation between sales representatives and product management. They may form a core team related to business case analysis in rapid productisation.

The relevant quotations on delivery capability and product portfolio consistency issues are presented in Table 2.

Table 2. Business case issues related to rapid productisation

Issue	Excerpts from interview data
Delivery capability	A) *"Delivery organisation is responsible for deliveries. Assessing team has always someone involved from that organisation."* B) *"It is left for the project manager's or team leader's shoulders."* C) *"There is a clear process for that in case of a variant request." – "If a request concerns a case of not having ability to deliver, the process is bypassed and relevant teams are assigned to consider how to deliver."* D) *"Practically, ability to deliver means three issues: purchasing, logistics and manufacturing capability. In case of new third party item, the owner of the product must be found to discuss how to deliver." –"At worst, it is not verified when a deal is agreed."* E) *"It is assessed as a collaboratively by a business consultant and a sales representative. Of course they discuss with R&D and project team consider is it realism to get that capability."* F) *"Capacity is an issue which must be considered especially in SMEs"*
Consistency with product portfolio	A) *"The aim is to build an individual commercial product"* B) *"It is very important also in customer-specific applications to make as generic solutions as possible." – "There must be some policy to manage this."* C) *"It has to be completely in line with our product portfolio." – "Global product and its variants are always managed same way from the viewpoint of product hierarchy and product lifecycle management."* D) *"Product master data and portfolio structure data determine its compatibility rules. Which similar products this is compatible with and how it can be combined with other products."* E) *"It is an informal activity and there are not supporting processes."* F) *"Generally, there are many business issues to consider of what to include in the portfolio. Does the existing product structure provide possibility to combine a solution for the problem or market?*

Delivery capability is a crucial element behind a credible business case analysis for rapid productisation since the customer is expecting to know the delivery time. Nevertheless, the research data indicates that it may not belong to the analysis. Thus, delivery information may be provided by a separate delivery capability analysis or delivery project plan. Consistency with the product portfolio instead seems to be an essential part of business case analysis that must be included.

Productisation has strategic role in most companies, and product creation includes always risks. Table 3. presents quotations on these nonfinancial considerations.

Table 3. Strategy and risk considerations in rapid productisation

Issue	Excerpts from interview data
Business strategy	A) *"Assessed by business leaders."* B) *"Short-term and long-term key areas where the focus and which things are emphasised right now. Of course things come from customer interface, but the decisions are made at the top."* C) *"Strategy must be clear in terms of whether to make new variants or not." – "In most cases strategy consideration is not relevant but there may be cases where strategy affects very strongly."* D) *"Is the business strategy only to have a global product portfolio or also how much is local productisation allowed?" –"Business strategy belongs to senior management"* E) *"Subcontracting is a relevant option if a request is out of strategic scope."*
Risk analysis	A) *"Risk analysis is part of the sales process and depends on the size of client. Sales representative must be able to justify why the client is worth of investment."* B) *"For example, delivery risks are analysed e.g. possible component delivery problems." – " The account process includes risk analysis to clarify the financial standing of a client."* C) *"The normal risks which relates to productisation and running business. Profit risk - Is the cost structure of product known to determine the correct price? Is it known from where the product is sourced, who does supply it and how it is delivered? Also warranty issues, e.g. hardware service and associated costs. "* D) *"Project team is primarily responsible for risks and delivery."* E) *"Risk related to a possible partner. In principle, all the basic business risks."*

Strategic discussion has at least two levels related to rapid productisation. In the higher level, rapid productisation is either decided to accept or not as a business practice. This must be clear for sales representatives. In the lower business case level, strategic fit need to be considered with each rapid productisation business case. A common understanding seems to be that mostly the strategy is not an issue in business case analysis but potentially there may be cases where it is a crucial issue. Strategy consideration may affect strongly to the portfolio analysis, without strategic fit the case may never end up to the portfolio.

Although risks are always present in productisation, the research data indicates that they may not belong to the business case analysis as an individual element. Business case itself can be seen as a tool to manage business risks since it predicts business consequences of the case including cost and revenue estimations.

FINDINGS AND DISCUSSION

Business case is such a generic concept which any business-minded manager can produce, understand and utilise in decision making. Typically, business cases analysis practises are applied for the company specific needs and the practises vary a lot e.g. the level of formality,

is it personal or team effort etc. Some companies consider their analysis practise even as a source of competitive advantage since it potentially helps selective decision-making and succeed in setting profitable price level. Business case analysis as a systematical procedure is motivated by an intent to know true business value of potential investment. The procedure includes gathering relevant and trusted data, analysing the data in rational way, calculating predictable business consequences and synthesising the results to the formal business case document. This kind of procedure ignores personal, managerial and orgasational relationships as well as cultural issues which, in turn, may affect strongly to actual analysis in companies. Table 4. illustrates how does business case analysis for rapid productisation position itself in relation to the responding analysis for new product development.

Table 4. Business case analysis for rapid productisation in relation to the analysis for NPD

Content similarities	**Content differences**
- Necessitates development project plan - Analysis of item cost structure / unit cost - Financial assessment / calculations - Market potential analysed if the item is included in portfolio	- Strategic fit is mainly connected to the portfolio decision - Start from a customer-specific need
Included only in RP business case	**Lacking from RP business case**
- Include evaluation of sales case and of customer ship - Need to analyse whether to include to product portfolio - strategic fit	- Technological uncertainties out of scope - No delivery capability creation cost (utilises existing delivery capability and supplier base) - No competitor assessment

In the context of rapid productisation, business case analysis is quite straightforward. Explorative and constructive research approach enables to outline the principal logic and main issues: cost analysis; revenue estimation and strategic fit, for the procedure based on the research data. In Figure 2, we provide an illustrative example of business case analysis procedure for rapid productisation. However, adopting the procedure necessitates careful consideration of the organisation specific and type of business needs.

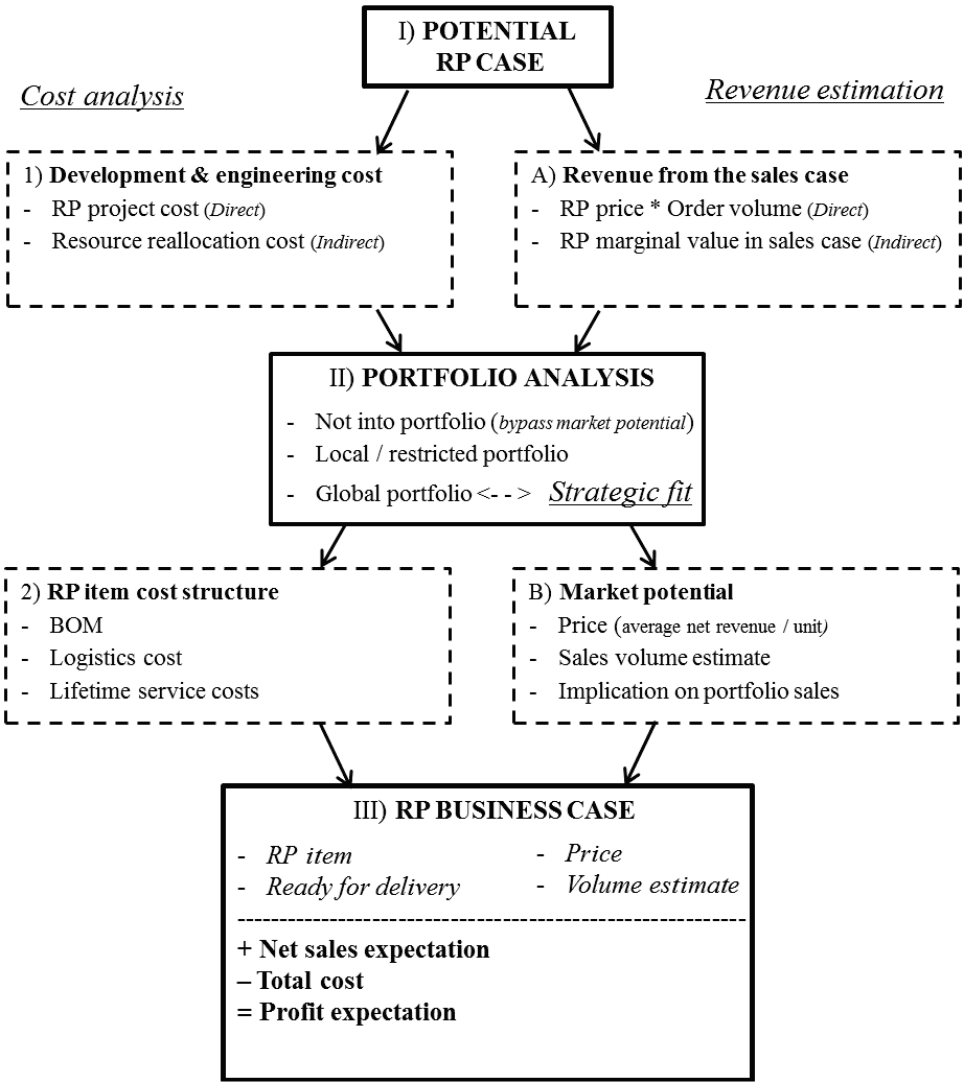


Figure 2. An illustrative example on business case analysis procedure for rapid productisation

In rapid productisation decision-making is culminating in two points: 1) whether to carry out a potential RP case or not, and 2) whether to aim rapid productisation (RP) item only at one customer or at the portfolio. The example procedure flows through two phases. In the first round, a potential RP case is roughly analysed as a RP project to clarify related development and engineering costs. Based on the first-round cost-revenue comparison, the case can be either eliminated or analysed further from portfolio viewpoint. Analysis continues if the RP case includes strategic fit and is aimed at the portfolio. In the second round market potential of RP item is evaluated by predicting sales window and estimating price level and development time, sales volume and impact on portfolio sales. Similarly, the cost structure of RP item from operations and lifecycle viewpoint need to be clarified and calculated. Finally, the estimates from first and second rounds are further synthesised as business case document which by its nature is aiding decision makers to decide whether to carry out the RP case. In case the decision is to carry out rapid productisation, business case serves sales representatives with customer communication, RP project team and product management, and RP item owner or product manager in business planning.

Seldom companies may face exceptional rapid productisation cases which have very strong impact to the strategy, either as a threat or as a new opportunity. In general, business strategy just guide whether rapid productisation is seen as an acceptable business practice. Productisation carries always risk and business case analysis assists to manage business risks. Risk is present through all the elements and it is not a separate analysis element. Only potential warranty costs include a clear risk that is priced. The warranty costs are associated with lifetime service costs. Risks could be taken into account by calculating different cost and market scenarios (e.g. Otto and Wood, 2001).

Business case analysis drives management to make well-informed decisions. A good question to be discussed is how much effort one should put on business case analysis for rapid productisation. It is challenging task to recognise the trade-off point after which more information would not anymore change the following decision. Furthermore, it is always possible that a strong business case does not lead to success and a weak business case would do. To summarise, analysis, estimation and future prediction includes always risk.

CONCLUSIONS

Many companies are demanded to offer wide variety of products and services to meet the diverse needs of customers and market. Evolving needs challenge companies' capability to react quickly enough. Rapid productisation can be used to changing or redesigning product modules on the fly to serve sales and order-delivery process.

New product business case analysis is clearly more extensive than the analysis for rapid productisation. For example technological uncertainties, competitive assessment and delivery capability creation cost are not included in business case analysis for rapid productisation. In turn, business case analysis for rapid productisation includes sales case analysis and portfolio analysis which are not part of NPD business case.

Business case of rapid productisation is constructed through revenue estimation, cost analysis and portfolio analysis activities according to our case study. In the first phase sales case is evaluated to estimate the revenue, and project and engineering cost is analysed. In the second phase, if the rapid productisation aims at product portfolio, market potential is analysed to estimate the total revenue, and cost structure of RP item. Finally, all the information and data is synthesised into a business case document which include essentially profit expectation and such RP item basic data as price, ready for delivery date and volume.
The results of this are applicable at least for companies which currently apply the configure-to-order delivery mode. Our business case analysis procedure is limited to RP cases which can be as an individual item which may have own business plan. Results of this exploratory case study are not general but need to be applied to the company context considering especially used delivery mode and customer order point. Sales representatives, product managers and researchers interested in productisation may find our findings as benchmark object and could further validate the results in their contexts. Further research would include how to recognise the trade-off point after which more business case information would not change the following business decision.

REFERENCES

1. Carbonell-Foulquie, P., Munuera-Aleman, J. L. and Rodriguez-Excudero, A. I., (2004), Criteria employed for go/no-go decisions when developing successful highly innovative products. *Industrial Marketing Management,* Vol. 33, 307-316.
2. Chung, W. W. C., Ko, C. C. Y., Cheung, E. W. M. and Wong, T. C. W, (2007) "IT-enhanced order and delivery process of a fast moving consumer goods (FMCG) company: A case study", *Benchmarking: An International Journal*, Vol. 14 Iss: 1, pp.123-139.
3. Cooper, R. G., (2001), Winning at New Products: Accelerating the process from idea to launch. Perseus Publishing, Cambridge (Mass.).
4. Cooper, R. G. and Kleinschmidt, E. J., (2007), Winning Businesses in Product Development: The Critical Success Factors. *Research Technology Management* Vol. 50, No. 3, pp. 52-66.
5. Gautam, N., and Singh, N. (2008), "Lean product development: Maximizing the customer perceived value through design change (redesign)", *International Journal of Production Economics.* Vol 114, pp.313-332.
6. Hänninen, K., Muhos, M and Haapasalo, H. (2013) "Business Justifications for Rapid Productisation in Small- and Medium -Sized Companies", *Technology Innovation and Industrial Management, TIIM 2013 Conference, 29-31 May, 2013, Thailand.*
7. Hart, S., Hultink, E. J., Tzokas, N. and Commandeur, H. R., (2003), Industrial companies' evaluation criteria in new product development gates. *Journal of Product Innovation Management,* Vol. 20, pp. 22-36.
8. Henard, D. H. and Slymanski, D. M., (2001), Why some new products are more successful than others. *Journal of Marketing Research* Vol. 38, pp. 362-371.
9. Hietala J, Kontio J, Jokinen J and Pyysiainen J (2004) "Challenges of software product companies: results of a national survey in Finland", *Proceedings 10th International Symposium on Software Metrics.* IEEE: pp. 232-243.
10. Hvam L, Mortensen NH and Riis J (2008) Product customization. New York, Springer.
11. Keen, J. M. and Digrius, B., (2003), Making technology investments profitable: ROI road map to better business cases. Wiley, Hoboken (N.J.).
12. Kinnunen, T., Pekuri, A., Haapasalo, H., and Kuvaja, P. (2011), "Business case analysis in new product development", *Global journal of management and business research.* Vol. 1 No. 1, pp. 49-56.
13. Koen, P., Ajamian, G., Burkart, R., Clamen, A., Davidson, J., D'Amore, R., Elkins, C., Herald, K., Incorvia, M., Johnson, A., Karol, R., Seibert, R., Slavejkov, A. and Wagner, K., (2001), "Providing clarity and a common language to the "fuzzy front end"". *Research Technology Management,* Vol. 44, No. 2, pp. 46-55.
14. Kratochvi´l M and Carson C (cop. 2005) Growing modular: mass customization of complex products, services and software. Berlin, Springer.
15. Randall, W. S., Brady, S. P., and Nowicki, D. R. (2012), "Business case analysis and the confounds of innovation driven by performance-based postproduction support strategies", *Transportation Journal.* Vol. 51, No. 1, pp. 33-58.
16. Ronkainen, I. A., (1985), Criteria changes across product development stages. *Industrial Marketing Management* Vol. 14, pp. 171-178.
17. Saaksvuori, A., and Immonen, A., (2008) Product lifecycle management 3rd ed. Berlin, Springer.

18. Ulrich, K.T. and Eppinger, S.D., (2008), Product design and development 4th ed. McGraw-Hill, Boston.
19. Otto, K.N., and Wood, K.L (2001) Product design: Techniques in reverse engineering and new product development. Upper Saddle River, New Jersey, Prentice Hall.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

GREEN PRODUCT POSITIONING AND PURCHASE INTENTION IN MALAYSIA

Sathiswaran Uthamaputharan, International Business School, Universiti Teknologi Malaysia, International Campus, Kuala Lumpur, Malaysia
Email address:sathiswaranw@gmail.com

Muslim Amin, International Business School, Universiti Teknologi Malaysia, International Campus, Kuala Lumpur, Malaysia
Email address: tengkumuslim@yahoo.com

Main Author
Sathiswaran Uthamaputhran is a student of MBA in International Business School, Universiti Teknologi Malaysia. He is also a full time lecturer in Universiti Malaysia Kelantan. The author's research interests are marketing, green marketing and entrepreneurship. He intends to pursue his research on green products and green marketing.

Co-Author
Dr. Muslim Amin, a Ph.D holder in quality and productivity improvement. His primary research interest is consumer behavior issues, service quality, customer satisfaction and behavioral intentions. His papers have been published in The Service Industries Journal and International Journal of Islamic Middle Eastern Finance and Management.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

GREEN PRODUCT POSITIONING AND PURCHASE INTENTION IN MALAYSIA

Sathiswaran Uthamaputharan, International Business School, Universiti Teknologi Malaysia, International Campus, Kuala Lumpur, Malaysia
Email address:sathiswaranw@gmail.com

and Muslim Amin, International Business School, Universiti Teknologi Malaysia, International Campus, Kuala Lumpur, Malaysia
Email address: tengkumuslim@yahoo.com

ABSTRACT

Purpose: *In this study, an overall framework for green marketing strategies is presented. The framework shows all green marketing strategies influencing customers' purchasing intention. This paper also stresses that certain green marketing strategies are independently influencing the purchasing behaviour and some are dependent on other factors namely the brand positioning.*

Design/methodology/approach: *This paper examines the constructs of green marketing strategies to identify how customers are convinced to purchase green products in Malaysia. As one of the marketing strategies is reliant on brand positioning, the existing theories such as the Elaboration Likelihood Model (ELM) and the Affect-Reason-Involvement (ARI) are referred. This paper constitutes the quantitative results of customers through questionnaires with the size of 400 respondents. The questionnaires were analysed using AMOS version 20.0 which is a structural equation modelling solution for marketing research.*

Findings: *This study is expected to distinguish the influence of the green marketing strategies components on customers purchasing intention. By doing this, the prominent green marketing strategy in determining customer decision making is highlighted. Thus, a new direction for green product marketers focusing on customers' intention to purchase is established.*

Research limitations/implications: *Lack of green knowledge towards green concepts due to different locations and cultures among customers may be problem encountered during this study. This is a fundamental implication to this study especially in Malaysia as it has various ethnicities.*

Originality/value: *This paper presents all the green marketing strategies together with related brand positioning factors in determining the customers' purchasing intention. Thus far, the existing researches only feature these strategies as factors impacting customers' decision in purchasing green products. However in this work, the appropriate green marketing strategy in deciding customers' behaviour is indicated.*

INTRODUCTION

From the past decade, environmental issues have been given much attention globally. Many researchers, academicians and practitioner have contributed and are still working to solve and improve the environmental issues. Besides that, the awareness of environmentalism has lead to green product decision making. Mc Kinsey in 2007 stated that people around the world from France, China Greece and U.S has continuously support the green products which cited by (Sanzero 2009) (Rylander 1993) (Sirgy 1991) . In certain countries customers are willing to pay more for products provides value for them due to different product positioning.(Cathy J. Cobb-Walgren 1995). In Malaysian context, hypermarkets and supermarkets such as Tesco and Carefour also have turned their business strategies by supporting environmental preserving activities. Among the commonly practiced activities in these stores are "No Plastic Day" on every Saturday and providing recycling items collection bins to increase the awareness of consumers while participating in the global interest of preserving the environment. (Mohd Helmi Abd Rahim 2012). Green positioning is defined as a subset of attribute, benefits and environmental values that convinced green customers to be loyalty over green products(T.Vukasovic, 2011)(Patrick Hamann, 2005). Green customers refer to individuals that buy products with high environmental conscious and knowledge(Ricky Y.K. Chan, 2000).Overtime as more customers switch on to green products, there is an argument on the subject of types of positioning; functional attributes and emotional benefits which have become obsolete. (L. J. Shrum 1995) .This situation occurs as customers only focus on green products that give immediate impact for them rather than being loyal to it. (Oliver 1999). Even though there is a negative rumor about traditional types of product positioning, these product positioning has to be taken into consideration as a basic foundation to identify customer attitudes and behaviors.

The purpose of this study is to identify the effect of green positioning strategies (functional attributes and emotional benefits) towards product attitudes and customer's intention to purchase. The recent study contributes to the future literature along with understanding of the effectiveness of basic green product positioning and the relationship product attitudes and purchase decision.

In the next section, the related studies on functional attributes, emotional benefits, product attitudes and intention are clearly conversed. Next, the research methodology which emphasized on methods, sample and data collection and following by structural model analysis and finally discussion, conclusion, limitation and future direction.

LITERATURE REVIEW

Functional Attributes

From the empirical studies by past researcher, functional attributes is defined as a device that provide information about the products and intangible tools for promote the green products for customers. (Patrick Hartmann 2005) The definition of functional attributes is consistent with the prominent theory and justification of personal satisfaction; perceive value to the products, physical justification, usage effectiveness and reliability which lead to build brand names for

organizations in the society. (A. Belén Del Río 2001) Researchers in the green literature examined the role of functional attributes or in other words "utilitarian" serve the customers with an effective informational marketing which indirectly create the beliefs toward the product or brands. (Sirgy 1991)

Emotional Benefits

Symbolic benefits or value- expressions defined as a transformational advertising segment highlighted on creating “characteristics” for the brands with a specific objective. (Sirgy 1991) Such conceptualization of emotional encompasses tendency of green product benefits through image basically react as a mediator over customer's cognitive process and the likelihood of green products(Keller, 1993)(Woon Bong Na, 1999) .In recent times however there is a strong argument by Lisa especially role of emotional benefits which is just for build a brand image and reputation and not really focus on quality. (Wood 2007)

Product Attitudes

Product attitudes defined as a subset of correlation between beliefs and values of customer's behavior towards different types of green products in the business market. Product attitude has been classified into different dimension with the principle of rising customers attraction on green products.(Syed Saad Hussain Shah 2012) The structure of product attitudes in green products induces by environmental consequences and individual consequences as main parameters which indirectly support the customers purchase intentions. This favorable relationship between the parameters and product attitudes are likely to foster future customers purchasing intention, which is based on brand positioning ((T.Ramayah, 2010). In several big companies, product attitudes will responsible to connect marketing strategies such as “story telling” to enlarge the understanding of the product and services offered. In fact, it has the capability to change customer's memory and create the desire to purchase (Hung Chang Chiu, 2012) However in this study, its represent as a mediation between independent variables (functional attributes and emotional benefits) and dependent variable (intention to purchase).(Scott B Mac kenzie, 1986)(Andrew A. Mitchell, 1981) (Iman Khalid A.Qader, 2010)

Functional Attributes - Product Attitudes

The impact of functional attributes as a super ordinate product positioning factor instantaneously influences customers' purchase intention on green products which manifest from positive motivation (M Joseph Sirgy, 1991). Some studies have stated that value and quality such as price, features of product is the main indicator to determine the customers understanding of green product concepts (Jin-Soo Lee, 2010). Normally in some environmental companies, if there is a lack of functional attributes the number of customers that have been loyal is also affected. However, companies fail to create an impact on customers, as imitation is the main barrier of using functional attributes compared to emotional benefits. (Heesup Han, 2011)

Emotional Benefits -Product Attitudes

Classic theories basically stress the chaining effects between customer behaviors and purchase intention. Different dimensions in past theories lead to existences of different personality such as sincerity, capability and enthusiasm towards green products(Aaker 1997) .Real nature and feeling towards the product attitudes is emotionally effect the customer purchase intention(Patrick Hartmann, 2008)(Sirgy, 1982). In one articles by J.J Gross, he explained that, this personality or behavior is derived from the signaling theories which aligned with emotional cues. It's actually a process that functions as an instrument that transforms the level of behavior in mental cognitive. The Antecedent - Response -Focused -Emotional Model in 1998 is a clear example to understand emotional cues and behaviors (Gross, 1998).

Product Attitudes – Intention

Although there is a common confirmatory between product attitudes and intention to purchase, the key area that significantly influences the product attitudes is customers' brand attachment. The review of literature point out that, product attachment behavior such as feeling and positive images is the key implication that creates customers attitude towards green products and influences to intention to purchase (C.Whan Park, 2010) (H.Bui, 2005). Apart from that, numerous researchers and practitioners also have emphasized the effectiveness of demographic profile such as age and education towards purchase intention (Abhishek Dwivedi, 2012)(Heesup Han, 2011)(Zakersalehi, 2012). For instances, customers who have knowledge about the importance of environmental issues, is easily engaged with the green products compared those with conventional products. In modern research, researchers have started to focus on the degree of involvement likelihood in green products in other terms researchers are paying more attention to customers' product attachment. Therefore, the higher the involvement in the green products, the higher the involvement likelihood will be. (Jung - chae Suh, 2006)

Hypothesis Development

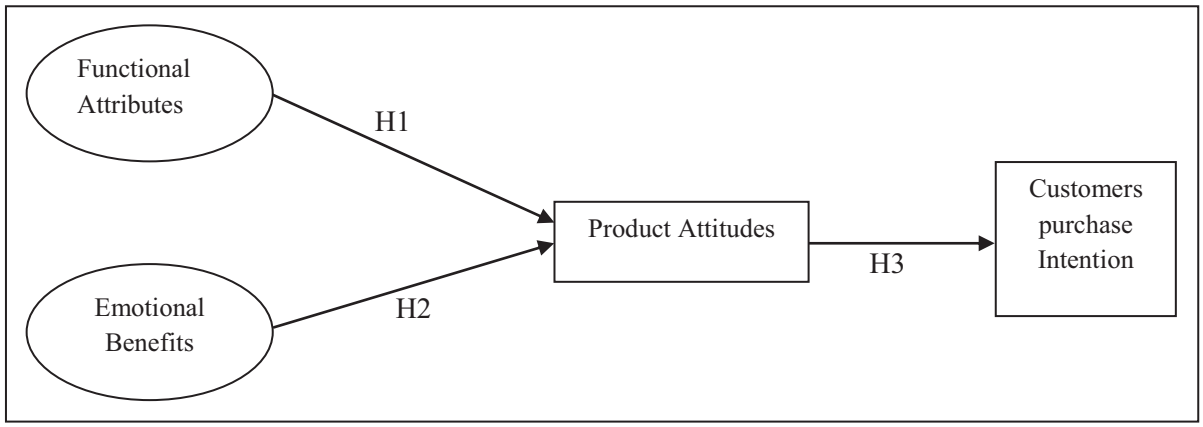


Figure 1: Proposed Research Model

Hypothesis

H1: Functional attributes have positive effects on product attitudes
H2: Emotional benefits have positive effects effect on product attitudes
H3: Product attitudes have positive effects on purchasing intention

METHODOLOGY

Method

In this confirmatory study, a self - administered questionnaire was used on a scale used in previous studies. The sampling frame consists of green product positioning and market strategies towards customers purchase intention. In this study, Giant and Econ Save are the two stores selected as location to conduct the survey. These stores are selected due to the high density of customers' frequencies in visiting these stores. Normally this self administered questionnaire is better compare to other survey instruments. This questionnaire has the ability to reduce the acquiescence and dis-acquiescence bias. All items used are base on customers' perspectives and their response towards green products. The questionnaire consists of 10 items on customers product positioning (functional attributes, emotional benefits and product attitudes) and 4 items on purchase intention of customers towards green products in supermarkets. All items are measured by using the 5-Likert scale ranging from 1 -5 denoting strongly agree to strongly disagree.

Sample and Data Collection

The population for this study is consists of customers in the Giant and Econ save supermarket, which considered as among the top visiting supermarket by Malaysian peoples. The respondents for this study are 500 and after excluding all the respondent bias and unusable responses a total of 200 questionnaires were used for this analysis. Thus, the accepted response rate for this study is 40%. A part from that, there is no limitation for the respondent or even any criterion for them to answer the survey. The respondents have pick up randomly to make the questionnaire easier to answer.

RESULT

Measurement model

Based on finding in this study, structural Equation Modelling (SEM) using AMOS software version 20 is the best method to get the accurate output for exogenous and endogenous latent variables. Some of the prior studies also stressed the measurement of research model is basically identify through the construct reliability, convergent validity and discriminant validity.

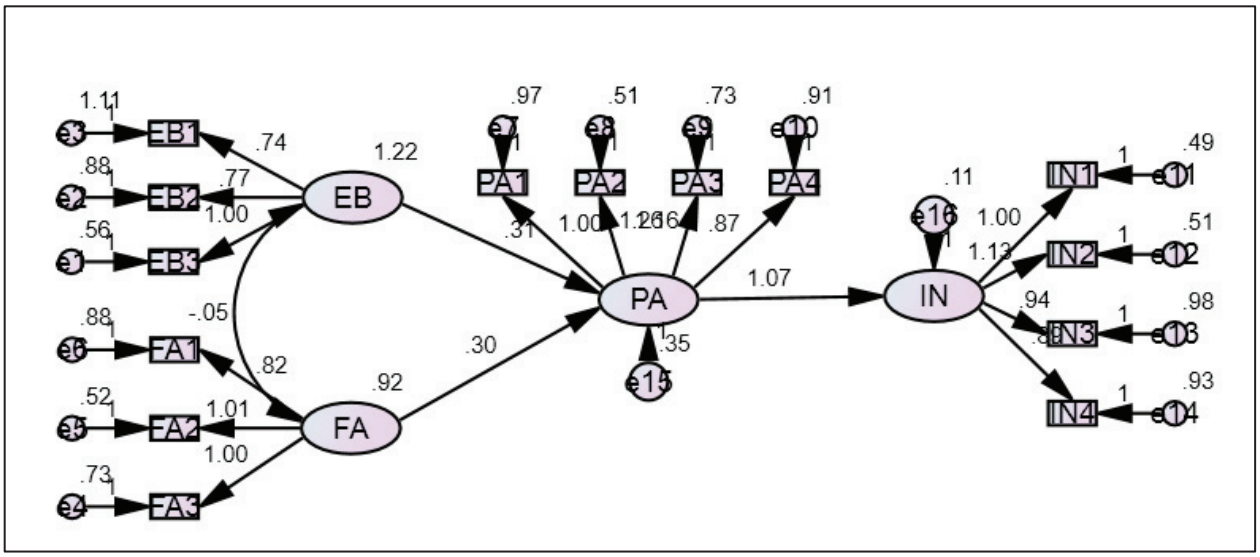


Figure 2: SEM analysis of research model

In general, the good model fit is accessed and measured using several elements such as chi squares degree of freedom, goodness of fit index (GFI) adjusted goodness of fit index (AGFI), comparative fit index (CFI) and root mean squared error (RMSEA).This all measurements have its own standard and cut off value was recommended such as chi square degree of freedom should not exceeded 3, goodness of fit index (GFI) should not exceeded 0.9, adjusted goodness of fit index (AGFI) should exceeded 0.8, non-norms fit index (NNFI) should exceed 0.9, comparative fit index (CFI) should exceed 0.9 and root mean squared error (RMSEA) should not exceeded 0.08.

The result of reliability analysis for all items has been perform and given in Table 1. In general composite reliability value and the average variance extracted (AVE) is the key assessment to identify the effectiveness of convergent validity. The cut off value to all factors loading must exceed 0.6 which used similarly by some researcher to their studies (Caroline A Haynes, 2000).For average variance extracted (AVE) the cut off value is must exceed 0.5.

Table 1: Measurement Model

Construct	Item/Actual Loading	Loading	Average Variance extracted (AVE)	CR
Functional Attributes	**FA1**	**0.609**	**0.501**	**0.748**
	FA2	**0.669**		
	FA3	**0.828**		
Emotional Benefit	**EB1**	**0.646**	**0.539**	**0.777**
	EB2	**0.801**		
	EB3	**0.747**		
Product Attitude	**PA1**	**0.598**	**0.448**	**0.761**
	PA2	**0.791**		
	PA3	**0.707**		
	PA4	**0.557**		
Intention	**IN1**	**0.774**	**0.509**	**0.804**
	IN2	**0.806**		
	IN3	**0.632**		
	IN4	**0.623**		

Table 2: Discriminant Validity [1]

	Functional Attributes	Emotional Benefit	Product Attitude	Intention
Functional Attributes	**0.734**			
Emotional Benefit	-0.047	**0.707**		
Product Attitude	0.375	0.442	**0.669**	
Intention	0.345	0.408	0.662	**0.713**

[1] Diagonal elements signify average variance extracted and the rest signify the variable -correlation

Based on table 1 above, the factor loading for all item is achieve their cut off value and in the correct direction exception of 2 items (Product attitudes 1 and product attitudes 2) which have 0.598 and 0.557 as an cut off value. Even though the AVE power of other three constructs is stronger and reaches the satisfactory of discriminant validity but one construct (Product Attitudes) does not have high AVE compare with the rest at 0.448.In an overall scheme the discriminant validity has been achieved and with AVE of constructs is better than the rest of the constructs. The correlation of all constructs is lower that AVE.

Structural Model

The model fit analysis revealed that X^2/df was 2.13, GFI - 0.897, AGFI - 0.901, CFI - 0.918, RMSEA - 0.075 and p- value is highly significant. This finding implied the significant levels of each constructs and their relationship between each other. The overall scheme of the model and path shows that the range is at 0.30 which show positive significant and the variance enlighten at the range of 30%. We can conclude that, the model is enough fit to be fit in this study in the maximum level.

Table 3: Structural Model

Hypothesis	Un- standardized Beta	Standardized Beta	Standard Estimate	C.R.	P.Value	Decision
H1- FA →PA	**0.304**	**0.396**	**0.070**	**4.367**	**0.001**	**Support**
H2- EB →PA	**0.308**	**0.461**	**0.065**	**4762**	**0.001**	**Support**
H3- FA →IN	**1.075**	**0.922**	**0.139**	**7.710**	**0.001**	**Support**

*** p>0.001

Following the measurement model and validity in this study, the structural model is assesses the relationship between the independent variables and dependent variables. Thus, this analysis representing the hypothesis that tested to determine whether it's supported or rejected. The output of this process is basically engaged with the prior's studies which stressed that there is a positive affect for all variables. In examining the relationship between functional attributes and product attitudes there is a positive affect at p>0.001 and $R^2$is 0.07.Hence H1 is supported. This result is similar to previous study which emphasize on positive relationship between functional attributes and product attitudes(Olivier Mairesse, 2012) .On the other hand, emotional benefits has ultimately create a positive relationship with product attitudes at the significant level p> 0.001 and $R^2$is 0.06. The reactions of customers over emotional benefits have strong relationship when they visit supermarket .Therefore H2 is supported. This finding are consistently has tested this variable and its show that positive relationship between emotional benefits and product attitudes (Patrick Hamann, 2005). Finally, relationship between product attitudes and intention is examined and the result indicates that there is a positive effect over product attitudes towards intention at the significant level p>0.001 and $R^2$is 0.13. It's correlated with the (Patrick Hartmann, 2008) that product an attitude has a significant relation with customer's intention to purchase. So H3 is supported.

DISCUSSION AND CONCLUSION

This study has created a platform to determine the effectiveness of green product positioning towards customer's purchase intention in Supermarkets. Some of the previous studies have argued that using one type of product positioning is enough to convince customers but this study has empirically confirmed that both product positioning have positive effects on customers' intention to purchase. From the result, its shows that functional attributes has a stronger effects on customers' intention to purchase over emotional benefits. For instances, high green knowledge over the environmental issues makes green customer more aware of the green product qualities. Thus, they afford to pay more to the green products due to the quality of the products and immediate benefits. On other hand, demographic factors also play a vital role in increases role of functional attributes. Basically education and genders are the most significant factors that indirectly position the green products Invalid source specified.. Likewise emotional benefits also have significantly affected the customer attitudes leading to purchase intention. Feeling and love towards green products is highly correlated with the intention to purchase. For instance, the "story telling" about the green products can simply convince the green customers to be loyal with the products. Thus this situation actually creates good attitudes towards the products as with hypothesis which is supported. However, it is difficult to summarize that the effectiveness of both product positioning equally play an important role to determine the customer intention to purchase. Therefore, combining both functional attributes and emotional benefits produces more concrete strategy in determining customer intention to purchase. Consequently, this study also increase the understanding of the marketers and producers that already in the market to specify green product positioning that can motivate customers to purchase.

Limitation and Future Direction

A major criticism of this study is respondent's lack of green knowledge and awareness of the green products. Different knowledge of the green concepts among the respondents affects the questionnaire that answered. Most of them actually struggle with the questions in the questionnaire because it's actually new for them. Another limitation of the study is the effectiveness of emotional benefits which is not completely tested in this research as Malaysia is a multicultural country having vast ethnic citizen. This inadequacy is due to the different cultural, socio- economic and believes that practicing in Malaysia. Future research should focus on one specific product categories and the result must be clear for that specific green products. It will more explain more appropriate to understand the effectiveness of product positioning. Nevertheless, future researcher also can include more sub- variables to functional attributes and emotional benefits such as love, quality, and price and so on to get better result and understanding of effects of variables towards dependent variable.

REFERENCES

1. A. Belén del Río, R. V., Víctor Iglesias. "The role of the brand name in obtaining differential advantages." *Journal of Product & Brand Management* 10, no. 7 (2001): 452 - 465.
2. Aaker, Jennifer L. "Dimensions of brand personality." *Journal of Marketing Research* 34, no. 3 (1997): 347.
3. Abhishek Dwivedi, Bill Merrilees, Dale Miller, Carmel Herington. "Brand, value and realtionship equities and loyalty- intentions in the Australian supermarket industry." *Journal of Retailing and Consumer Services* (Elsevier) 19 (2012): 526- 536.
4. Andrew A. Mitchell, Jerry C.Olson. "Are Product Attitude Beliefs the only Mediator of Advertising Effects on Brand Attitude?" *Journal of Marketing Research* 18, no. 3 (August 1981): 381-32.
5. C.Whan Park, Deborah J. Maclnnis, Joseph Priester, Andreas B. Eisingerich & Dawn lacobucci. "Brand Attachment and Brand Attitude Strength :Conceptual and Empirical Differentiation of Two Critical Brand Equity Drivers." *Journal of Marketing* (American Marketing Association) 74 (November 2010): 1-17.
6. Cathy J. Cobb-Walgren, Cathy J. Cobb-Walgren, Cynthia A. Ruble and Naveen Donthu. "Brand Equity, Brand Preference, and Purchase Intent." *Journal of Advertising* 4, no. 3 (1995): 25-40.
7. Gross, James J. "The Emerging Field of Emotion Regulation:A Integrative Review Psychology." *Review of General* (Educational Publishing Foundation) 2, no. 3 (1998): 271-299.
8. H.Bui, My. "Environmental Marketing: A Model of consumer Behaviour." *Annual Meeting of the Association of Collegiate Marketing Educators.* 2005. 20-28.
9. Heesup Han, Li- Tzang Jane Hsu, Jin- Soo Lee, Chwen Sheu. "Are lodging ready to go green?An examination of attitudes, demographics and eco-friendly intentions." *International Journal of Hospitality Management* (Elsevier) 30 (2011): 345-355.
10. Hung Chang Chiu, Yi- Ching Hsieh, Yi Chu Kuo. "How to Align your Brand Stories with your Products." *Journal of Retailing* 88, no. 2 (2012): 262-275.
11. Iman Khalid A.Qader, Yuserrie Zainuddin. "Intention to Purchase Green Electronic Products:The Consequences of Perceived Government Legislation,Media Exposure and Safety &Health Concern and the Role of Attitude as Mediator." *International Journal of Innovation,Management and Technology* 1, no. 4 (October 2010): 432-439.
12. J. S. Johar, M. Joseph Sirgy. "Value-Expressive versus Utilitarian Advertising Appeals: When and Why to Use Which Appeal." *Journal of Advertising* 20, no. 3 (1991): 23-33.
13. Jin-Soo Lee, Li-Tzang (Jane) Hsu,Heesup Han,Yunhi Kim. "Understanding how consumers view green hotels: how a hotel's green image can influence behavior intention." *Journal of Sustainable Tourism* 18, no. 7 (September 2010): 901–914.
14. Jung - chae Suh, Youjae Yi. "When Brand Attitudes Affect the Customer Satisfaction - Loyalty Relation:The moderating Role of Product involvement." *Journal of Consumer Psychology* (Lawrence Erlbaum Association) 2 (2006): 145-155.
15. Keller, Kevin Lane. "Conceptualizing,Measuring and Managing Customer- Based Brand Equity." *Joural of Marketing* 22 (1993): 1-22.

16. L. J. Shrum, John A. McCarty and Tina M. Lowrey. "Buyer Characteristics of the Green Consumer and Their Implications for Advertising Strategy." *Journal of Advertising* 24, no. 2 (1995): 71-82.
17. M Joseph Sirgy, J.S Johar, A.C Samli, C.B Claiborne. "Self- Congruity Versus Functional Congruity : Predictors of Consumer Behavior." *Journal of Academic of Marketing Science* 19, no. 4 (1991): 363-375.
18. Mark Brown, Nigel Pope, Kevin Voges. "Buying or Browsing? An exploration of shopping orientations and online purchase intention." *European Journal of Marketing* 37, no. 11/12 (2003): 1666-1684.
19. Mohd Helmi Abd Rahim, Ros Zayanah Johari Ahmad Zukni, Fauziah Ahmad and Novel Lyndon. "Green Advertising and Environmentally Responsible Consumer Behavior: The Level of Awareness and Perception of Malaysian Youth." *Asian Social Science* 8, no. 5 (2012): 46-54.
20. Olivier Mairesse, Cathy Macharis, Kenneth Lebeau and Laurence Turcksin. "Understanding the attitude-action gap: functional integration of environmental aspects in car purchase intentions." *Psicológica* 33 (2012): 547-574.
21. Patrick Hamann, Vanessa Apaolaza Ibanez, F.Javier Forcada Sainz. "Green Branding effects on attitude:functional Versus Emotional Positioning Stategies." *Marketing Intelligence & Planning* 23, no. 1 (2005): 9-29.
22. Patrick Hartmann, Vanessa Apaolaza-Ibanez. "Virtual Nature Experiences As Emotional Benefits In Green Product Consumption:The Moderating Role of Environmental Attitudes." *Environmental and Behavior* 20 (2008): 818-842.
23. Ricky Y.K Chan, Lorett B.Y Lau. "Antecendents of green purchases:A survey in China." *Journal of Consumer Marketing* 17, no. 4 (2000): 338-357.
24. Scott B Mac kenzie, Richard J. Lutz, George. E. Belch. "The Role of Attitude Towards the Add as a Mediator of Advertising Effectiveness: A Test of Competing Explanations." *Journal of Marketing Research* 23, no. 2 (1986): 130-143.
25. Sirgy, M.Joseph. "Self - Concept in Consumer Behavior:A Critical Review." *Journal of Consumer Research* 9, no. 2 (1982): 287.
26. Stephen W. McDaniel, David H. Rylander. "Strategic Green Marketing." *Journal of Consumer Marketing* 10, no. 3 (1993): 4-10.
27. Syed Saad Hussain Shah, J. A., Ahsan raza Jaffari, Sidra Waris, Wasiq Ejaz,Maira Fatima and Syed Kamran Sherazi. "The Impact of Brands on Consumer Purchase Intentions." *Asian Journal of Business Management* 4, no. 2 (2012): 105-110.
28. T.Ramayah, Jason Wai Chow Lee, Osman Mohamad. "Green Product purchase intention:Some insights from a developing country." *Resources, Conservation and Recycling* 57 (2010): 1419-1427.
29. T.Vukasovic. "Conceptual Model of Strategic Positioning of a poulty brand." *World poultry science Journal* 67 (December 2011): 643-652.
30. Whitney Sanzero, Adam Heying. "A Case Study of Wal-Mart's "Green" Supply Chain Management." Operations Management, 2009.
31. Wood, Lisa. " Functional and symbolic attributes of product selection." *British Food Journal* 109, no. 2 (2007): 108 - 118.

32. Woon Bong Na, Roger Marshall,Kevin Lane Keller. "Measuring Brand Power:Validating a model for optimizing brand equity." *Journal of Product and Brand Management* 8, no. 3 (1999): 170-184.
33. Zakersalehi, Mohammad Zakersalehi and Amin. "Consumers' attitude and purchasing intention toward green packages foods;A Malaysian perspective." *International Conference on Economics Marketing and Management.* 2012. 1-5.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

MEASUREMENT OF DISCONFIRMATION IN ONLINE PURCHASING BEHAVIOR

Chinho Lin, Institute of Information Management of National Cheng Kung University, Taiwan R.O.C.
Email: linn@mail.ncku.edu.tw

Yu-Huei Wei, Department of Industrial and Information Management of National Cheng Kung University, Taiwan, R.O.C.,
Email: r38001043@mail.ncku.edu.tw

ABSTRACT

Purpose: *Service quality measurement in e-shopping service is an area of growing interest to researchers and managers. The purpose of this study is to explore the disconfirmation in online purchase behavior based on the expectancy disconfirmation theory (EDT).*
Design/ methodology/approach: *A two-phase study is designed to collect data and 657 usable samples were obtained. The participants are asked to fill out a questionnaire before and after purchasing in web store. A structural equation modeling (SEM) is used to assess the research model.*
Findings: *This study presents the evidence of the scale's factor structure, reliability, content validity and discriminant validity based on the results of analysis. The results also reveal that Disconfirmation, expectation and perceived usefulness has been influenced by second-order factors.*
Research limitation/ Implication: *This study aims on widely e-shopping customers without controlling the kinds of goods or services for participants purchased. The framework can be adopted to investigate the impact of different type and price for goods or services in the future study.*
Originality/ value: *The framework is built through SEM method, and several critical factors included are proposed to measure the disconfirmation in online purchasing behavior.*

Keywords: Online purchase, E-service quality, E-commerce, Expectancy disconfirmation theory (EDT), Structural equation modeling (SEM), Measurement

INTRODUCTION

With the rapid growth of the Internet, more and more people are participating in the Internet activity and increasing electronic commerce (e-commerce). An increasing number of businesses are utilizing the World Wide Web as a marketing channel to deliver their products and services (Li et al. 2006). Moreover, the existence of the virtual marketplace facilitates the interaction between consumers with a wide array of product choices (Lim and Ting 2012), and Internet become a popular channel for business marketing.

For a long time, customer satisfaction is an important factor for marketing research. The tradition marketing research confirms that customer satisfaction is one of the mean factors of repurchase in various different industrial (e.g., Hallowell 1996; Rust and Zahorik 1993). Recently, on the e-commerce or electronic applications literature, satisfaction also is a mean factor for the research. For instance, Eid (2011) believes that ensuring customer satisfaction is the goal of online sellers, and satisfaction is believed to influence post-purchase intention to repurchase a product or reuse a service (Yen and Lu 2008). Moreover, Lee (2010) argues that Satisfaction is the strongest predictor of users' continuance intention, followed by perceived usefulness, attitude, concentration, and perceived behavioral control as significant. Therefore, not only tradition business but also e-business is pursuing increase customer satisfaction.

Disconfirmation is the gap between the consumer's expectations of the product or service and perceived performance (Yen and Lu 2008), it is the psychological state results from a cognitive. According to Oliver (1980) cognitive model of satisfaction decisions, the expectancy disconfirmation theory (EDT) was developed, and has been widely used in the marketing field to understand consumers' intentions. The studies almost to reported the relationship of expectation, perceived performance, customer satisfaction and how customer intentions change over time. There was absence of research projects dealing with explore the measurement scale. In this research, we propose the measurement scale and model for the disconfirmation in online purchase behavior.

THEORETICAL BACKGROUND

Expectancy Disconfirmation theory

The success of business depends on that how can they keep the customer and catching business opportunities. The satisfaction is crucial to fostering customer loyalty, that is viewed as the key to building and retaining a loyal base of long-term consumers (Anderson and Sullivan 1993).

The disconfirmation theory proposes that a key determinant of product evaluation is the product's performance relative to initial expectations (Darke et al. 2010).

The Expectancy Disconfirmation theory (EDT) was developed by Oliver (1980) cognitive model of satisfaction decisions that consumers' post-purchase satisfaction is jointly determined by pre-purchase expectation and disconfirmation, that is widely used in the marketing and consumer behavior research. Churchill and Surprenant (1982) argues that perceived performance could also affect satisfaction directly, and sometimes it emerges as the only influence. In general, EDT was used to discussing of consumer satisfaction, repurchase intentions, post-purchase behavior, service marketing, and used to predict the consumers' product repurchase and service continuance use.

Recently, EDT has been used to understand consumers' intentions in the e-commerce context. Some studies show that disconfirmation and performance are important factors in explaining satisfaction (e.g., Bhattacherjee and Premkumar 2004; Chih et al. 2012; Khalifa and Liu 2003), and Yen and Lu (2008) found that buyers' disconfirmation is positively associated with their satisfaction, and satisfaction is positively associated with loyalty intentions.

Conceptualization of disconfirmation

Disconfirmation is the psychological state results from a cognitive appraisal of expectation and perceived performance. Disconfirmation theory posits that satisfaction is an evaluative outcome of the gap between performance and expectations (Oliver and Desarbo 1988). Yi & La (2004) defined disconfirmation was perceived discrepancy between prior expectations and performance. Kopalle & Lehmann (2001) also defined disconfirmation- sensitive consumers are those who are more satisfied/ dissatisfied when products perform better/ worse than expected. This study defined the disconfirmation as perceived discrepancy between initial expectations and perceived usefulness. Lower expectation and/ or higher performance lead to greater confirmation, which in turn positively influence consumers' satisfaction.

The Disconfirmation is the gap of cognitive between expectation and perceived performance, which used in online purchasing behavior can be affected by many dimensions, and that multidimensional concept associate with satisfaction. Yen et al. (2008) argues that efficiency, privacy protection, contact, fulfillment, and responsiveness have statistically influences on buyer's disconfirmation (Yen and Lu 2008). Bhattacherjee (2001_b) used performance, productivity, effectiveness and overall evaluate to measurement perceived usefulness construct, and used experience, service level and overall evaluate to measurement confirmation construct.

Kauffman and wood (2006) argues that customer will tend to pay more for the goods with the pictures on the web store. Zeithaml et al. (2002) detailed that information availability and content, ease of use, privacy/security, graphic style and reliability/fulfillment as relevant to e-SQ perceptions. Wolfinbarger and Gilly (2003) argues that Efficiency, system availability, fulfillment, privacy, responsiveness, compensation and contact is the eTailQ scale. Lee et al. (2011) used perceived value, perceived ease of use, perceived usefulness, firm's reputation, Privacy, trust, reliability and functionality to understand the relationships with online repurchase intentions. Liang and Lai (2002) found that the quality of e-store design has an effect on the consumer purchase decision. Consumers are effect more likely to shop at well-designed websites. Teo and Yeong (2003) also found that the perceived risk has a negative relationship with consumers' overall evaluation of the deal, and overall evaluation of the deal has a positive relationship with consumers' willingness to buy online.

According to previous literatures, this study used eleven items to measurement consumers' initial expectation, perceived usefulness and disconfirmation that including concept of service of internet store, efficient of transaction process, security, convenient of internet store, save money of online purchasing, easy navigation of website, the products' complete, the description of the products, deal experience, evaluation of purchasing decision, evaluation of overall shopping experience.

METHODOLOGY

Sampling and Data Collection

Empirical data for this study was collected via two-phase field survey; we conducted a survey based on respondents' online purchasing experience. The data for our study were collected through a web-based questionnaire. We set up an online survey website, and the participants complete the survey questionnaire before them purchasing the goods or services; in addition, when the participants get the goods or services, they must fill out the questionnaire again. We used the participant's e-mail address and web store name to comparing the sample data was come from the same respondent. A sample of 657 respondents was obtained. The sample consisted of 64.5% women and 35.5% men.

Measurement instruments

Three constructs were measured in this study: Initial Expectation, perceived usefulness, and disconfirmation, among initial expectation was measured before the participant online

purchasing and both of perceived usefulness and disconfirmation were measured after they get the goods. Items were measured using seven-point Likert scales anchored between “strongly disagree” and “strongly agree”.

Most of the measuring instruments were extended from Bhattacherjee (2001_a) and Khalifa and Liu’s (2007), in addition to this, some instruments were adapted from EDT, e-commerce, and e-service quality research. There are eleven measure items, respectively, would measuring constructs of Initial Expectation, perceived usefulness, and disconfirmation.

Analysis and Results

The structural equation modeling (SEM) approach was used to assess if the model fit the data set. The first step was developing a measurement model by confirmatory factor analysis (CFA), that was evaluated on the criteria of reliability, convergent validity, and discriminant validity.

A confirmatory factor analysis (CFA) was to test the reliability and validity of the measurement model. Table 1 shows the descriptive statistics and correlation. Figure 1 show that each item’s standardized loading for disconfirmation. All loading value is exceeding 0.55. But the values of fit indices were not within the threshold of recommended values. Therefore, we consider four latent factors.

The Figure 2 and table 2 show the result of consider four latent factors. Standard item loadings were over 0.70 and all items were significant at the 0.001 level. Composite reliability of each factor was all above 0.70. All AVEs of factors range from 0.7 to 0.86, well above the recommended value 0.5. The results to achieve the criteria of convergent validity assess, that standard loading of each item on its underlying factor should be over 0.7 (Gefen et al., 2000), composited reliability should be above 0.7, and the average variance extracted (AVE) should exceed 0.5 (Bagozzi and Yi 1988). The result shown the convergent validity was established. In Table 3, the most square root of the AVE for each factor was larger than the correlation of any specific factor with any of the other factors, showing that we had discriminant validity. This study also considers second order factor analysis, the result as shown in figure 3, and the goodness of fit for Model1, Model 2 and Model 3 are compared in Table 4.

Table 1. Descriptive statistics and correlation

	Mean	SD	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
D1. The service of internet store.	4.94	1.15	1										
D2. The efficient of transaction process.	5.33	1.27	0.67	1									
D3. The security of internet store.	5.07	1.19	0.70	0.67	1								
D4. The conveniently of internet store.	5.41	1.15	0.66	0.73	0.75	1							
D5. The function of save money by online products.	5.03	1.24	0.51	0.51	0.46	0.55	1						
D6. Can be easy navigation of website.	5.15	1.16	0.54	0.55	0.54	0.61	0.59	1					
D7. The completely products.	5.09	1.18	0.61	0.61	0.60	0.65	0.60	0.78	1				
D8. The internet store provides descriptions of the products.	4.98	1.18	0.64	0.59	0.61	0.65	0.56	0.68	0.77	1			
D9. The internet store will provide an excellent deal	5.05	1.23	0.56	0.53	0.51	0.56	0.78	0.58	.670	0.67	1		
D10. Evaluation of purchasing decision.	5.23	1.14	0.67	0.65	0.63	0.70	0.66	0.67	0.73	0.75	0.76	1	
D11. Evaluation of overall shopping experience.	5.29	1.18	0.65	0.65	0.62	0.69	0.67	0.67	0.68	0.70	0.71	0.85	1

Note: Correlations is all significant at the 0.001level (two-tailed)

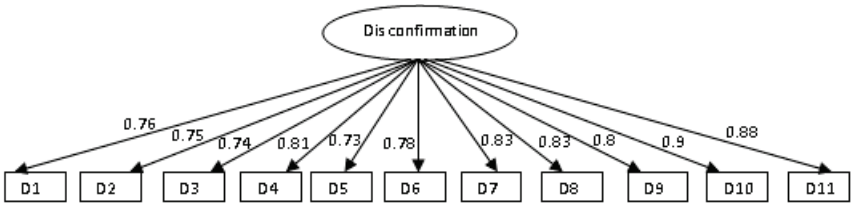


Figure 1. Model 1 testing results

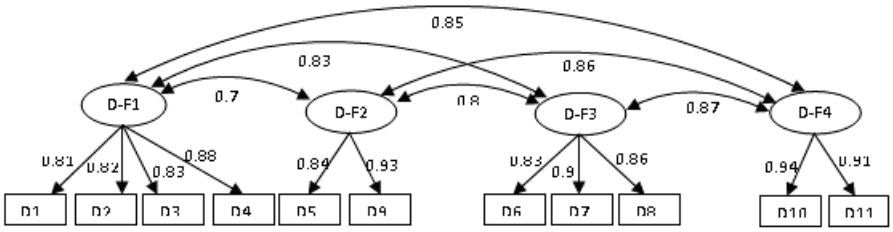


Figure 2. Model 2 testing results

Table 2. Results of Convergent Validity Testing

Factor	Item	Std. Loading	Error Loading	AVE[a]	CR[b]
D_F1	D1	0.81	0.46	0.70	0.87
	D2	0.82	0.52		
	D3	0.83	0.43		
	D4	0.88	0.31		
D_F2	D5	0.84	0.47	0.79	0.78
	D9	0.93	0.42		
D_F3	D6	0.83	0.25	0.75	0.89
	D7	0.9	0.36		
	D8	0.86	0.20		
D_F4	D10	0.94	0.15	0.86	0.90
	D11	0.91	0.25		

[a]AVE is average variance extracted, $\rho_v = \sum \lambda_i^2 / [\sum \lambda_i^2 + \sum var(\varepsilon)]$
[b]CR is composited reliability, $\rho_c = (\sum \lambda_i)^2 / [(\sum \lambda_i)^2 + \sum var(\varepsilon)]$

Table 3 discriminant validity

	D_F1	D_F2	D_F3	D_F4
D_F1	**0.84**			
D_F2	0.7	**0.89**		
D_F3	0.83	0.8	**0.86**	
D_F4	0.85	0.86	0.8	**0.92**

Note: Values in the diagonal row are square roots of the average variance extracted. The other cells contain the correlation between constructs.

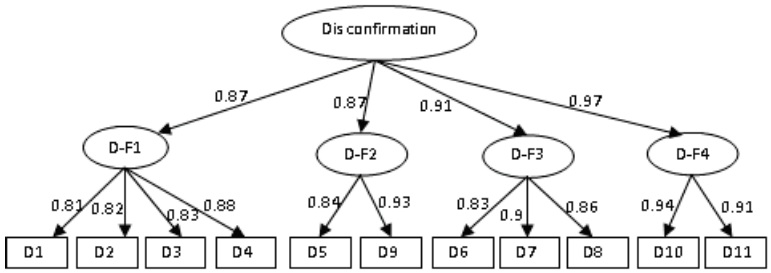


Figure 3. Model 3- second order model

Table 4. Goodness of fit statistics

			Disconfirmation		
			Model 1	**Model 2**	**Model 3**
X^2/df	<5	(Bentler,1989)	22.24	4.58	5.65
RMSEA	<0.06	(Hu and Bentler, 1999)	0.18	0.07	0.08
NFI	>0.9	(Bentler and Bonett, 1980)	0.94	0.99	0.98
NNFI	>0.9	(Bentler and Bonett, 1980)	0.92	0.99	0.98
CFI	>0.95	(Bentler, 1989)	0.94	0.99	0.98
GFI	>0.9	(Hu and Bentler, 1999)	0.79	0.95	0.94

CONCLUSION

This study aims on widely e-shopping customers without controlling the kinds of goods or services for participants purchased. Our study developed and tested three models explaining the measurement of disconfirmation model in online purchasing behavior. We suggest eleven items to measure the construct of disconfirmation, and the items are influenced by four latent factors, and we also test the second-order model.

REFERENCES

1. Anderson, E. W., and Sullivan, M. W., (1993), "The Antecedents and Consequences of Customer Satisfaction for Firms", *Marketing Science*, Vol.12 NO.2, pp. 125-143.
2. Bagozzi, R. P., and Yi, Y., (1988), "On the evaluation of structural equation models", *Journal of the Academy of Marketing Science*, Vol.16 NO.1, pp. 74-94.
3. Bhattacherjee, A., (2001_a), "An empirical analysis of the antecedents of electronic commerce service continuance", *Decision Support Systems*, Vol.32, pp. 201-214.
4. Bhattacherjee, A., (2001_b), "Understanding information systems continuance: an expectation- confirmation model", *MIS Quarterly*, Vol.25 NO.3, pp. 351-370.
5. Bhattacherjee, A., and Premkumar, G., (2004), "Understanding changes in belief and attitude toward information technology usage: a theoretical model and longitudinal test",

MIS Quarterly, Vol.28 NO.2, pp. 229-254.

6. Chih, W.-H., Wang, K.-Y., Hsu, L.-C., and Cheng, I. S., (2012), "From disconfirmation to switching: an empirical investigation of switching intentions after service failure and recovery", *The Service Industries Journal*, Vol.32 NO.8, pp. 1305-1321.
7. Churchill, G. A., and Surprenant, C., (1982), "An investigation into the determinants of customer satisfaction", *Journal of Marketing Research*, Vol.19, pp. 491-504.
8. Darke, P. R., Ashworth, L., and Main, K. J., (2010), "Great expectations and broken promises: misleading claims, product failure, expectancy disconfirmation and consumer distrust", *original empirical research*, Vol.38, pp. 347-362.
9. Eid, M. I., (2011), "Determinants of e-commerce customer satisfaction, trust, and loyalty in Saudi Arabia", *Journal of eledtronic commerce research*, Vol.12 NO.1, p 16.
10. Gefen, D., Straub, D. W., and Boudreau, M. C., (2000), "Structural equation modeling and regression: guidelines for research practice", *Communication of the Association for Information Systems*, Vol.4 NO.7, pp. 1-70.
11. Hallowell, R., (1996), "The relationships of customer satisfaction, customer loyalty, and profitability: an empirical study.", *International Journal of Service Industry Management*, Vol.7 pp. 27-42.
12. Kauffman, R. J., and Wood, C. A., (2006), "Doing their bidding: An empirical examination of factors that affect a buyer's utility in Internet auctions", *Information Technology and Management*, Vol.7 NO.3, pp. 171-190.
13. Khalifa, M., and Liu, V., (2003), "Determinants of satisfaction at different adoption stages of internet-based services", *Journal of the Association for Information systems*, Vol.4 NO.5, pp. 206-232.
14. Khalifa, M., and Liu, V., (2007), "Online consumer retention: contingent effects of online shoppinghabit and online shopping experience", *European Journal of Information Systems*, Vol.16, pp. 780-792.
15. Kopalle, P. K., and Lehmann, D. R., (2001), "Strategic management of expectation-the role of disconfirmation sensitivity and perfectionism", *Journal of Marketing Research*, Vol.38 NO.3, pp. 386-394.
16. Lee, C. H., Eze, U. C., and Ndubisi, N. O., (2011), "Analyzing key determinants of online repurchase intentions", *Asia Pacific Journal of Marketing and Logistics*, Vol.23 NO.2, pp. 200-221.
17. Lee, M.-C., (2010), "Explaining and predicting users' continuance intention toward e-learning: An extension of the expectation–confirmation model", *Computers & Education*, Vol.54 NO.2, pp. 506-516.
18. Li, D., Browne, G. J., and Chau, P. Y. K., (2006), "An empirical investigation of web sit use using a commitment-based model", *Decision Sciences*, Vol.37 NO.3, pp. 427-444.

19. Liang, T.-P., and Lai, H.-J., (2002), "Effect of store design on consumer purchases: van empirical study of on-line bookstores", *Information & Management*, Vol.39, pp. 431-444.
20. Lim, W. M., and Ting, D. H., (2012), "E-shopping: An Analysis of the Uses and Gratifications Theory", *Modern Applied Science*, Vol.6 NO.5, pp. 49-63.
21. Oliver, R. L., (1980), "A cognitive model of the antecedents and consequences of satisfaction decisions", *Journal of Marketing Research*, Vol.17 NO.4, pp. 460-469.
22. Oliver, R. L., and Desarbo, W. S., (1988), "Response determinants in satisfaction judgments", *Journal of Consumer Research*, Vol.14, pp. 495-507.
23. Rust, R., and Zahorik, A., (1993), "Customer satisfaction, customer retention, and market share", *Journal of Retailing*, Vol.69, pp. 193-215.
24. Teo, T. S. H., and Yeong, Y. D., (2003), "Assessing the consumer decision process in the digital marketplace", *Omega*, Vol.31 NO.5, pp. 349-363.
25. Wolfinbarger, M., and Gilly, M. C., (2003), "eTailQ: dimensionalizing, measuring and predicting etail quality", *Journal of Retailing*, Vol.79 NO.3, pp. 183-198.
26. Yen, C.-H., and Lu, H.-P., (2008), "Effects of e-service quality on loyalty intention: an empirical study in online auction", *Managing Service Quality*, Vol.18 NO.2, pp. 127-146.
27. Yi, Y., and La, S., (2004), "What influences the relationship between customer satisfaction and repurchase intention? Investigating the effects of adjusted expectations and customer loyalty", *Psychology and Marketing*, Vol.21 NO.5, pp. 351-373.
28. Zeithaml, V. A., Parasuraman, A., and Malhotra, A., (2002), "Service Quality Delivery through Web Sites: A Critical Review of Extant Knowledge", *Journal of the Academy of Marketing Science*, Vol.30 NO.4, pp. 362-375.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

EXPLORATION OF CONSUMERS' BEHAVIOURS CONNECTED WITH PRODUCT REUSE

Monika Nalewajek, Maria Curie-Skłodowska University, Faculty of Economics, Lublin, Poland, Pl. M.C. Skłodowskiej 5, 20-031 Lublin, Poland
E-mail: mnalewajek@wp.pl

Radosław Mącik, Maria Curie-Skłodowska University, Faculty of Economics, Lublin, Poland, Pl. M.C. Skłodowskiej 5, 20-031 Lublin, Poland
E-mail: radoslaw.macik@umcs.lublin.pl

Radosław Mącik holds Ph.D. in Economics from Maria Curie-Skłodowska University in Lublin, Poland – Faculty of Economics. His research interests are focused on consumer and organizational behaviour, particularly on ICT adoption influence on such behavior, as well as on quantitative and qualitative marketing research methods, including online research.
Monika Nalewajek, M.A. in Management. Currently doctoral student at Faculty of Economics, Maria Curie-Skłodowska University in Lublin, Poland. She specializes in qualitative research techniques. Her current research interests include consumer behavior, particularly topics connected with responsible consumption, packaging and social media.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

EXPLORATION OF CONSUMERS' BEHAVIOURS CONNECTED WITH PRODUCT REUSE

Monika Nalewajek, Maria Curie-Skłodowska University, Faculty of Economics, Lublin, Poland, Pl. M.C. Skłodowskiej 5, 20-031 Lublin, Poland
E-mail: mnalewajek@wp.pl

Radosław Mącik, Maria Curie-Skłodowska University, Faculty of Economics, Lublin, Poland, Pl. M.C. Skłodowskiej 5, 20-031 Lublin, Poland
E-mail: radoslaw.macik@umcs.lublin.pl

ABSTRACT

Purpose: *Purpose of this paper is to explore consumers' behavior connected with product reuse, particularly to assess what product categories are reused more frequently and why. Also paper deals with consumer motivations, knowledge and inspirations to reuse. Product reuse is operationally defined for this paper as usage of particular product in a new context, way of use ect. – not as usage for the same purpose by new owner.*
Design/methodology/approach: *Authors are using virtual ethnography as main data collection technique, supplemented by secondary data sources. Observation will use selected social media portals, including status and fanpages on Facebook (likes, comments and sharing), as well as Pinterest and Pinspire (pin and follow activities).*
Findings: *Main drivers to product reuse are not connected with simple ecological motives – those are important to some users, but only as additional motivations. Observation leads to conclusion, that most often reasons to engage in product reuse are connected with the needs to express yourself and show own creativity and individualism, mainly by DIY (Do It Yourself) activities leading to product reuse. Another reasons to engage is seeking savings (not always monetary). Research is suggesting also that people need inspiration, some things that trigger such behavior, they often need to see possibilities before they can change their attitudes toward product reuse.*
Research limitations/implications: *Main study limitation is qualitative approach to analysis. Subjective selection of places and subjects for observation may be perceived as another shortcoming. Careful data analysis should overcome those shortcomings.*
Practical implications: *Findings from the analysis will be useful for marketing practitioners to create marketing activities promoting ecological behavior.*
Originality/value: *Taken approach originally uses virtual ethnography to study conscious and unconscious motives for product reuse. This leads to revealing alternative ways of indirect shaping consumers' attitudes toward ecological consumption.*

Keywords: product reuse, motivations, thriftiness, creativeness, social media
Classification: research article

INTRODUCTION

The issue of reuse of the products is becoming more and more significant in an era when consumers are constantly bombarded by information about the deteriorating state of the environment, depletion of resources, consumption-driven lifestyle, or even exacerbating economic crisis.

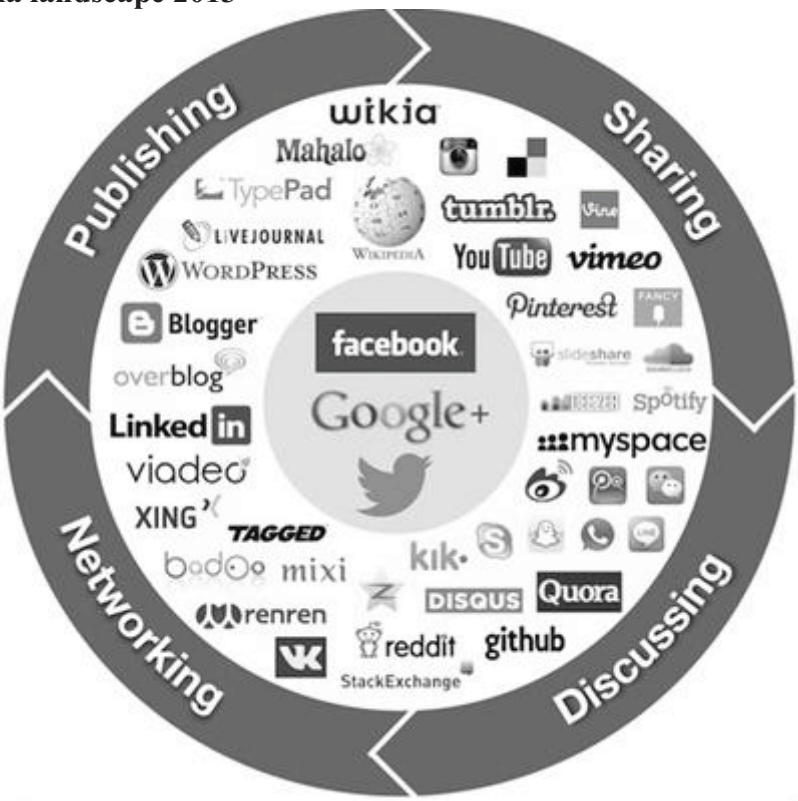
Re-use of products is part of the philosophy of "3R" (Horsman, Brown, Munro, Kendon 2011): reduce, reuse, recycle, and therefore, is the most commonly identified with pro-ecological behavior. The various propositions are trying to extend this formula for a further Rs, such as rethink, repair, refuse and so one. Adopted point of view seems to be well founded. There are many incoming messages seeking to develop and strenghten attitudes of responsible consumption used in almost all media. These standard media are using typically different forms to spread this idea: television (news), radio (interviews), newspapers and magazines (articles); internet (dedicated portals). Also less standard forms as a custom viral campaigns, ambient campaigns, etc. have been deployed to reach this goal. However, with the development of the Internet, particularly social media, one can note different motivations for reuse than the standard attributed catching.

Deployment of quantitative research methods to assess issues connected with product reuse can lead to a rather typical and trite conclusions. This is due to the fact that the phenomenon of product reuse previously been interpreted in terms of taking care of the environment or the savings for low budget households. However, the observation of this phenomenon in Social Media allowed to point out the issues previously overlooked. Thus, the authors decided to use the method of virtual ethnography and maintaining a closer look at the product reuse. The research examined primarily Facebook.com portal, with additional and extended observations on Pinterest.com and YouTube.com.

SOCIAL MEDIA CHANNEL

The world of social media is now very rich. Every year it becomes more and more popular, mainly due to world-popular site Facebook.com.

Pic. 1 Social media landscape 2013



Source: Social Media Landscape 2013, online: http://www.fredcavazza.net/2013/04/17/social-media-landscape-2013/

Social media allow users to create communities - in several dimensions. One of them is to create groups of friends who know each other, so that they can stay together in constant contact (online), share interesting materials (text, audio / video, photos) directly on the website or in relation to external sites (e.g. redirecting the blogs). Another option is to group of fans gathered around a particular brand (physically existing on the market, but also the ideas treated as brands, people around ideas can create the brand from them). The third option is to create communities of interest – this is important for people who do not know themselves, they live in the remote parts of the world, speaking different languages – but can share common and rare interests and spread interesting content for them. This allows the circulation of certain ideas is much higher, reaching a much larger group of people than the traditional channels, as well as it reaches people who are much interested in the content to show some activity. Can it be (depending on the service) viewing the content – text, picture or videos (the most passive), press *like* button, comment and share on somebody's' profile. Staying even a passive observer of the content (which is the most common for about 90% of users) users are getting familiar with certain things, they develop their own opinions, they develop particular tastes, gain knowledge, gain greater awareness, which is particularly important for building a specific attitudes. The same is when they are using other tools (websites, blogs), but in social media:

- allowing for move from push to pull strategy , which is an advantage to the user, he or she (more often, through information and technology solutions) alone determines what content to display,
- user is itself informed when new content on sites that interest him is shown (for example, Facebook is the main catalyst and synthesizer of content that often link to

external sites), chooses those which are interesting and he/she wants to deeper explore, ignoring less interesting at the same time.

COMMON TYPES OF PRODUCT REUSE

At this point it is worth to systematize some knowledge. The reuse of product we can see as:

- the second life of product (Nalewajek and Mącik 2012)– change the function of the product; a situation in which the package is used in unchanged form again, despite finishing of basic product content, such as box of chocolates;
- upcycling (the most often type) – change the function of the product; upcycling is the reuse of materials as oppose to recycling them. Recycling is the reprossessing of used products down to raw materials and then into new products. Upcycling is reusing the materials without reprocessing them, for example cutting apart old clothing and making new products from the material. Any left-overs from the upcycling process can then be recycled. Upcycling requires less energy than recycling and can be done time and time again;
- the product exchange – changes only the owner of the product, now it works in the second circuit (eg clothes)

Pic.2 Example of second life of the product

Source: own research (2012)

THE PRODUCT REUSE – TYPICAL APPROACH

Looking at the chosen tools of social media (Facebook, Pinterest - portal allows you to create unique collections of photos, You Tube - a service for watching and collecting movies) it can be seen that some content types are spreading in one channel much more dynamically than in another. For example, searching through the channels - an ecological approach to product reuse is easier to find on Facebook or YouTube than Pinterest. It is associated with the capabilities of these services and perceived attractiveness of content, which can be obtained this way. Facebook allows you to create profiles (for people, brands, ideas) and collect of so-called fans around them, You Tube channel allows to collect subscribers, and the last one - Pinterest – you can create and follow specific boards with pictures. So results of seeking content data thus depends on the used keywords that we know - not always it is easy to guess them. Everything depends on t how the item (profile, video, photo) is tagged or described by the user. So by looking for word "reuse" we can find some results, but they are not complete.

There may be sections dealing with the product reuse, but calling themselves quite differently, for example, responsible consumption. In this way - on some sites, some content spread more easily, because they are called in better way.

For instance searching on Facebook for word *reuse* the authors found that for more than 100 profiles established, their names contain this string of letters. The number of fans ranges for them from a several dozen to several thousand (i.e. Reuseit fanpage has 17 052 fans). However, to verify the phenomenon of reuse must also be taken into account fanpage dealing with environmental behavior or responsible consumption, since the same "reuse" is only a small part of the ecological behavior. It is not possible to look at all, and the whole content they made and publish, because there are so many of them, and some of them are very intensively carried out (changes of status, new posts ect. occur in this case as often as every three hours).

Thanks to social media, their users are made aware of the issue of the effects of waste (e.g. by infographics, simple description of the photos and sometimes video), have presented the products can help to protect the environment (such as reusable bags and containers for lunch, instead of disposable bags, etc.). They also can spot the images where one can see the process by which the old items in a fast and simple way are transformed into something new. Users also can be introduced to the easy ways to get rid of old, unwanted items, which would be a problem with disposal or proper segregation of garbage.

Pic. 3 Examples of product reuse

Source: Pinterest.com

In addition to fanpages general in terms of content that revolve around themes reuse, you can already find these specializing in a more narrow subject, such as:

- clothing,
- bags,
- jewerly/watches,
- baby goods/kids goods,
- furniture,
- glass/jars/watter bottles,
- computers/technology.

In this way, a narrower group of interest in a particular specific area can be found and utilized to spread even very exotic ideas – but always strictly connected with fanpage topics covered.

WHAT IS HIDDEN?

Exploring the phenomenon of the product reuse through virtual ethnography in social media helped to point out quite important behaviors, which were not expected to be seen in such quantities. It turns out that the interest for product reuse connected topics can come not only from ecological reasons. More often it is dictated by the need or desire to do something by yourself (which is part of a DIY trend - do it yourself). Profiles on Facebook focused on this subject (DIY) have very fast growing number of fans (one, within three months - almost 90,000 of fans, the other, within two months - 84,000 of fans). Number of fanpages and the number of people interested in the content posted on it continues to grow. Major importance of such growth is the viral mechanism, ie. situation in which a particular user action learn his friends (depending on the settings of the profile) what is going on. In this way, the fanpage learn more and more new people. Naturally, if we analyze the number of the fans on different profiles - some of them would be covered. This reflects the degree of interest in the topic and the desire to stay up to date with the content. Intensity of getting messages and stronger interaction with posted messages can result in the substantial evolution of attitudes. Observing simplicity how to do various items by yourself, they can limit their own shopping and get satisfied using the compilation of products that already have at home. Very often in the analyzed social media channels were found remade and reused: clothing, household items - furniture (eg bed or table built from industrial pallets), organizers (the kitchen stuff) and things for the garden.

For some people watching, searching and sharing the images presenting things handmade from reusing other products is also a source of hedonistic feelings. Such things allow them to find inspiration over the Internet and then create unique solutions in the home. The most common were product types spotted here were furniture and household items.

Pic. 4 Hedonistic motivation of the product reuse – shelf made from chair and another from ladder

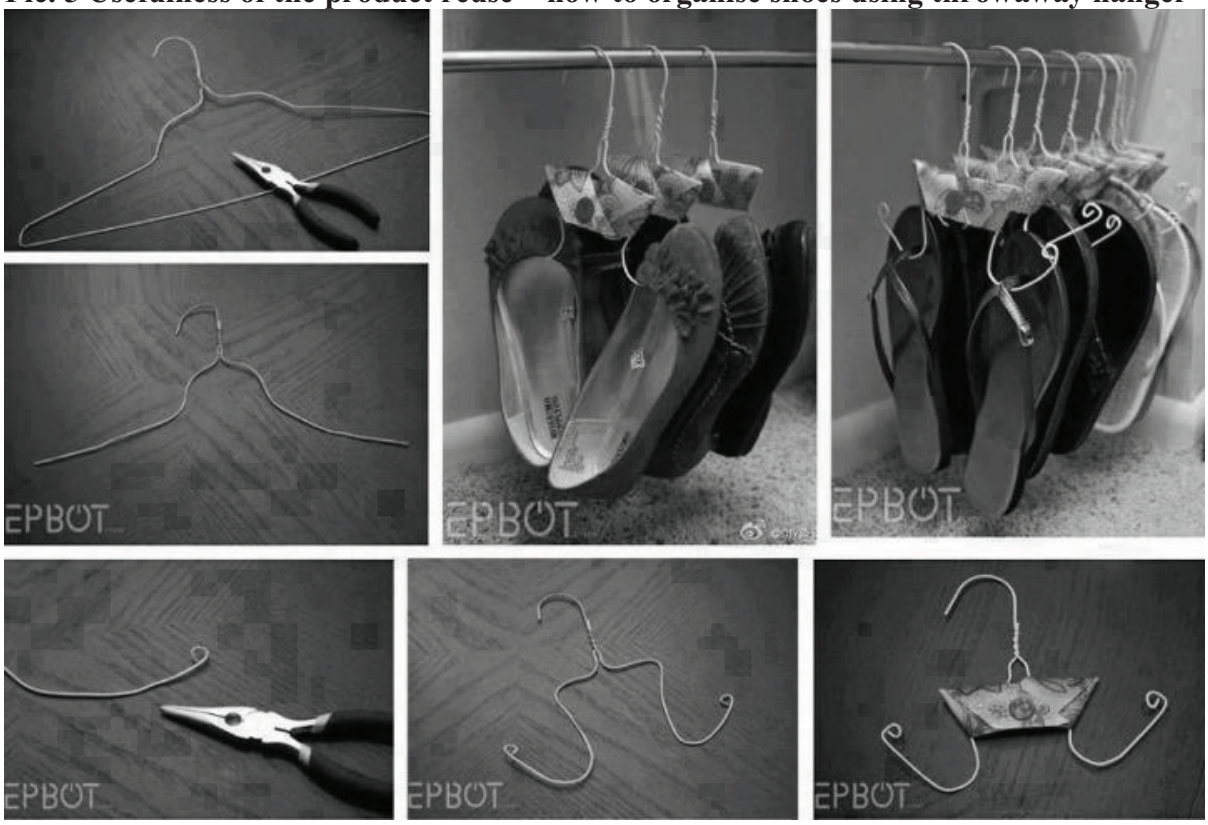
Source: Facebook.com

For the others finding new solutions by using old objects is the result of creative expression, for others who benefit from these solutions – form of award. Often they share these handmade products on their blogs presenting the product development stages as well as the end result - using the extensive photographic documentation (or video tutorial), along with a brief description.

For the young persons, because they are the main users of social networking sites and blog makers - is becoming an important aspect of the division (Młodzi 2011). They do not want their ideas to act for themselves, but spread throughout the world. In this way, individuals become creators, gaining popularity and recognition (often being identified with the name of the blog, nickname and not by name). Looking at it from a different perspective, you can see growing trend of C2C (consumer to consumer) exchange. Also when individuals are starting to show and set some trends, mass-production companies are in opposition to the unique concepts and design.

Yet another motive interest in the product reuse is the desire/need to look for useful solutions that simplify, organize some things. In this way, are conserved not only money but also time and effort (it is easier to find something in the house or harder to destroy, eg by breakage). In the case described, the important role played by Facebook, which acts as a catalyst for some content and allows you to enchant removing reference to external sources (often blogs devoted to this subject). Visible are also references to the videos on YouTube, where most young girls show how to use things in your home to prepare organizer for clothes (shawls, scarves, belts, underwear) or cosmetics. On Pinterest are created a whole collection of images dedicated to the theme. Often these are powerful images showing several smaller ones that illustrate the step-by-step how to get the effect discussed.

Pic. 5 Usefulness of the product reuse – how to organise shoes using throwaway hanger



Source: Pinterest.com

Another motive, so that people interested in the repeated use of the products is to spread the idea of creativity. Profiles / channels / boards (depending on social media platform) are filled with creative solutions, how to do something yourself. They encourage stimulating the imagination, inspire, create, shoving ideas. Analyzing the content of those sites from that angle you can see the word refer to overcome the daily grind, boredom, move away from mass production and buying products that "kill" thinking. Colorful pictures encourage the implementation of children's toys and learning them creativity. Pictures 6 illustrates the simplicity of implementation, short time needed to do and small amount of materials needed – those anyone have at home.

Pic.6 Toys for children made from reused products

Source: Facebook.com

Reuse is also connected with thriftiness. This is not necessarily associated with a lack of sufficient funds to buy new things, but associated with the deliberate reduction needs or responsible consumption . Observation of the content appearing in social media in this area has shown that often the content is shown in a very attractive way, that does not mean that somebody could feel touched, but it shows that saving can be fun, easy, nice and pleasant. It has to do with all the previously described phenomena.

Pic. 7 Saving money by using reused things

Source: Pinterest.com

Social media shows the richness of possibilities of the things you can save. Ways to reuse plastic bottles, glass jars, wooden items are countless proving it does not take much effort to achieve what you need in a very simple way. Any material can be used again.

WHY SOCIAL MEDIA?

Social media allows for a very fast rate spread some ideas. They are removing such barriers as:

- time - the content is available around the clock, constantly "refreshed" on the other fanpage boards, blogs, creating so called long tail effect,
- location - give access to almost every person on earth that has free access to the internet,
- language - the main medium of communication is an image rather than text. The Facebook statuses are short, comments are mostly in English, on Pinterest dominates the image, words are not enough to express all feelings needed; and You Tube offer tutorials that show how to get the effect to which the understanding of words is not often needed.

These portals intersect. Some refer to the latter. Facebook offers YouTube and Pinterest plug-in,. So it is easier to meet the data content that are still out there on the net. They are in a nice form - images are often nicely prepared, in a particular style with a suitably chosen typography.

Another issue is that the users of these sites are mostly young people, for whom a group of friends is a very important point of reference. The importance of family, tradition, humility

falls, creativity, resource fullness, self-confidence, individuality gains. All these factors make the product reuse becomes something totally different than it was previously interpreted.

IMPLICATIONS

Exploring the motivation to reuse helped to verify the situations of the product reuse widely regarded as the ecological. Such themes did not need to be dominant in behavior described in the text, there must also be conscious of the consumer, especially when for many people the care about the environment is not something interesting and involved, but on the contrary - a boring and far. The above qualitative data shed light on the direction of research in which quantitative research should go, so that could be undertaken to attempt to estimate the scale of the phenomenon.

Taken analysis suggests that underlying the repeated use of the product may be not only a desire to save, which has its economic consequences (the crisis). The issue of conservation is also a second meaning here. People want to not only save money (by reducing their purchases), but also a time (better organization of space) or effort (pre-purchase stage of buying process often become extended: consumers have to evaluate many alternatives before making a decision, rather than directly choose product that will look beautiful and perfectly answers their needs - without hours of searching in stores or online). Such dimension of saving has been not described up to date with reasonable depth.

Another issue is the scale of the problem. Netnography research shows that it is much bigger than we might think. Direct search can show a little, but to extend them for a certain word show that the situation of the product reuse is reflected also in other phenomena.

An important premise of the study is the "degree of independence" for consumers who turn away from the trends dictated by global brands, but are looking for simple solutions, which are the product manufactured themselves.

SUMMARY

Main drivers to product reuse are not connected with simple ecological motives – those are important to some users, but only as additional motivations. Observation leads to conclusion, that most often reasons to engage in product reuse are connected with the needs to express yourself and show own creativity and individualism, mainly by DIY (Do It Yourself) activities leading to product reuse. Another reasons to engage is seeking savings (not always monetary). Research is suggesting also that people need inspiration, some things that trigger such behavior, they often need to see possibilities before they can change their attitudes toward product reuse.

REFERENCES

1. Horsman C., Brown K. L., Munro W. J.,. Kendon V. M. ‘Reduce, reuse, recycle for robust cluster-state generation’. Phys. Rev. A, 2011. 83 (4) 042327.
2. Anderson, C. (2004).The Long Tail, Wired, 12(10).
3. Młodzi 2011, red. M. Boni, Kancelaria Prezesa Rady Ministrów, Warszawa 2011, p. 31, online: http://www.obserwatoriumkultury.pl/files/study/raport_modzi_2011_copy2.pdf

4. Nalewajek M, Mącik R., *Product Package Second Life – Exploratory Research of Secondary Use of Product Package*, "Knowledge and Learning: Global Empowerment. Proceedings of the Management, Knowledge and Learning International Conference 2012", ss. 731-739.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

AN EVALUATION OF MANUAL METERIAL HANDLING TASKS IN A MANUFACTURING COMPANY

Grepo, Lorelie, Department of Industrial Engineering and Operations Research, University of the Philippines, Diliman, Quezon City, Philippines

Yabis, David John, Department of Industrial Engineering and Operations Research, University of the Philippines, Diliman, Quezon City, Philippines

Po, Ronald Aaron, Department of Industrial Engineering and Operations Research, University of the Philippines, Diliman, Quezon City, Philippines

ABSTRACT

Manual material handling (MMH) is one of the most common causes of accidents and ill-health in the workplace. Material handling encompasses a wide range of work activities - from occasional movement of very large loads with cranes and powered industrial trucks to routine, repetitive lifting of relatively light objects and tasks that are incidental to a worker's regular, daily activities.

Manual material handling tasks in a Philippine manufacturer (the Company) of Baby Diapers and other personal products were evaluated and analyzed. Five months worth of data from the Company showed that 7% of workers suffer from work-related musculo-skeletal injuries. Of these, 58% are classified as low back pain. It should be noted that most Philippine companies are notorious for under-reporting workplace related injuries, particular those that only cause loss of man-hours (as opposed to losing man-days or months) due to relatively lax regulations though the Company encourages employees to report these types of injuries.

The manufacturing line for Product H (a baby diaper) was analyzed using ergonomic checklists for general posture, task evaluation, and workstation evaluation, as well as a Cumulative Trauma Disorder (CTD) Risk Index. It was seen that bulk packing, auto-bagging, manual sealing and box stacking are the most problematic among the tasks. Poorly designed workstations as well as heavy manual lifting and moving tasks contributed as likely main causes for low back pain.

Proposed solutions included an improved layout for the manual packing, auto-bagging and bulk packing workstations, job redesign of the on-line inspector, as well as job rotation among the different product lines.

INTRODUCTION

Manual material handling (MMH) is one of the most common causes of accidents and ill-health in the workplace. Material handling encompasses a wide range of work activities - from occasional movement of very large loads with cranes and powered industrial trucks to routine, repetitive lifting of relatively light objects and tasks that are incidental to a worker's regular, daily activities.

MMH activities are often of concern when assessing job tasks for risks that have the potential to lead to musculoskeletal disorders. MMH activities usually contain ergonomic risk factors that may include awkward posture, repetition, excessive force and mechanical or contact stress. Several evaluation methods and guidelines exist for evaluating manual material handling tasks.

Many of the work-related injuries associated with ergonomic problems include musculoskeletal disorders (MSD) such as back injuries and carpal tunnel syndrome and result from overexertion or repetitive motion. About one-third of these injuries are serious enough to require time off work. Workrelated MSDs account for one-third of all workers' compensation costs each year because these injuries can require a lengthy recovery time. Aside from the lost days of work, the corresponding amount of money lost because of it is significant that it can't be ignored.

It is then important to minimize, if not completely eliminate, the causes of these work-related MSDs to reduce the costs associated with these.

A. **Objectives**

The paper aims to

[1] identify work-related injuries and illnesses;
[2] evaluate and analyze specific tasks that can potentially cause manual material handling injuries;
[3] determine possible causes of these injuries and illnesses;
[4] identify other risks that may as well contribute to the injuries;
[5] analyze the factors in the work environment and layout that triggers work-related injuries and illnesses;
[6] utilizing appropriate tools in evaluating manual material handling practices

B. Scope and Limitation

This study covers one of the product lines of The Company, the infant care product line (disposable baby diapers). The Company manufactures different grades of infant care products. This study will focus on the production of Product H. It will be limited to the evaluation of the manual material handlers in the infant care division. The analysis will concentrate on the different tasks such as manual bulk packing, auto-bagging, manual box sealing, automatic box sealing, online inspector and box stacker. Only the workers in the first shift of this production line were observed. Other data that will be used such as the medical data on work-related illnesses and injuries are from recent records of The Company.

C. Methodology

In evaluating the manual material handling practices in The Company, the proponents first got medical records on incidences of work-related illnesses and injuries from the clinic. The records were analyzed, and then the analysis was concentrated in on musculoskeletal and soft tissues disorders since the number of incidences of work-related illnesses and injuries is the area of interest.

The injuries and illnesses were then related to the work done by identifying which factors are responsible for it. Several evaluation tools were used to aid in identifying these factors. The tools used were: Worksite/Job Analysis, CTD Risk Index and Workstation Evaluation Checklist.

Interviews were conducted as well as first hand observations in the production area to be able to accomplish these forms. After accomplishing the said forms, the tasks are analyzed in general to identify which has the highest probability of causing the injuries or increasing the risks.

Finally, recommendations on how to mitigate or eliminate the risks are provided at the end of the study.

E. Short Company Profile

The Company produces and markets a wide range of health and hygiene products. The Company is classified into three global business segments: Personal Care, Consumer Tissue and Business to Business.

Personal Care segment manufactures and markets feminine care products, disposable diapers and other related products. The Consumer Tissue segment produces and markets facial and bathroom tissue, paper towels, napkins and other products intended for household use. In contrast with the Consumer Tissue, the last segment which is the Business to Business manufactures the same products but is meant for away-from-home use. It also produces health care products such as surgical gowns, facemasks, exam gloves and respiratory products.

REVIEW OF RELATED LITERATURE

Manual material handling (MMH) is an activity requiring the use of force exerted by a person to lift, lower, push, pull, carry or otherwise move, hold, or restrain a person, animal or thing. It covers a wide range of activities including lifting, pushing, pulling, holding, throwing and carrying. It includes repetitive tasks such as packing, typing, assembling, cleaning and sorting, using hand-tools, and operating machinery and equipment.

In manual load handling, human effort intervenes in both a direct (raising, positioning) and indirect (pushing, hauling, shifting) manner. The carrying or holding of a load in a raised position is also considered to be manual handling. MH also includes holding the load with the

hands or other parts of the body, such as the back, and throwing the load from one person to another.

Because most jobs involve some form of manual handling, most workers are at risk of manual handling injury. Of course, not all manual handling tasks are hazardous. But it is significant that around a one-third of all workplace injuries are caused by MMH.

Some of the work-related injuries and long-term health problems are known as repetitive strain injury (RSI), occupational overuse syndrome (OOS), cumulative trauma disorder (CTD) and work-related musculoskeletal disorder (WRMSD). All of these conditions are referred to as musculoskeletal disorders (MSD). MSD is defined as an injury, illness or disease that arises in whole or in part from manual handling in the workplace, whether occurring suddenly or over a prolonged period of time.

Other injuries that may also be caused include: upper limb injuries (shoulders, arms and hands), burns produced by loads at high temperatures; wounds and scratches caused by excessively sharp corners, splintering, very rough surfaces, nails, etc.; bruising caused by falling loads due to slippery surfaces (oils, greases or other substances); circulatory problems or inguinal hernias and other harm produced by hazardous substance spills.

Many of the work-related injuries associated with ergonomic problems include MSDs such as back injuries and carpal tunnel syndrome and result from overexertion or repetitive motion. About one-third of these injuries (600,000) are serious enough to require time off work. Work-related MSDs account for one-third of all workers' compensation costs each year because these injuries can require a lengthy recovery time.

The International Labor Organization (ILO) maintains that manual handling is one of the most frequent causes of accidents at work, accounting for 20-25% of all those produced. A study carried out by the U.S. National Safety Council in 1990 revealed that the greatest cause of occupational injuries (31%) was overexertion. The back is the part of the body that most frequently suffers injury (22% of 1.7 million injuries). This problem also exists in many EU Member States. In the United Kingdom a report prepared in 1991 indicated that the cause of 34% of accidents resulting in injury was manual load handling. Of these accidents, 45% affected the back. In France during 1992 manual load handling was the cause of 31% of all accidents at work involving time off. In Spain, the greatest cause of accidents at work in the period 1994-95 was overexertion. In particular, statistics for 1996 relating to accidents at work and occupational diseases include 22.2% of accidents at work with time off caused by overexertion, many of them probably due to manual load handling. As regards the nature of the injury, 8.9% of accidents were due to lumbago and 0.1% a slipped disc.

PROBLEM IDENTIFICATION AND DOCUMENTATION

Data on work-related injuries and illnesses

Before evaluating the manual material handling practices in The Company, it is essential to identify the problems associated with improper manual material handling. To see this, date were gathered on the number of work-related musculoskeletal and soft tissues disorder (MSD) incidents. The tabulated summary of the data (five months) is shown in Appendix A. About 7% of workers suffer from workrelated musculo-skeletal and soft tissues disorder.

The data on work-related musculoskeletal and soft tissues disorder shows that low back pain contributes the most to the illnesses/injuries that workers suffer from. It constitutes 58% of workrelated musculoskeletal and soft tissues disorder in the company.

Tasks to be analyzed

The following jobs under the production of Product H are to be analyzed in the succeeding section of the paper. The proponents thought of analyzing the jobs individually and not to analyze the workers per se because the workers switch over in their work and it would be more difficult to make an analysis this way.

All the following tasks are dependent on the speed imposed by the process. The Product H machine produces 500 diapers per minute, so it is important that the workers are efficient in what they do, or else, the production of Product H would suffer.

[1] Bulk pack Packer – the worker packs Product H diapers directly into a box; a manual bulk pack packer averages 500 boxes per 8-hour shift

[2] Auto-bagger Packer– the worker packs the Product H diapers that are bagged in packs of 8 by the machine into a box; an auto-bagger averages about 657 boxes per 8-hour shift

[3] On-line Inspector – the on-line inspector inspects Product H randomly during the production; he/she sees to it that the Product H being produced and bagged are not defective; he/she also signals the line leaders if defectives come out of the process so they can either check the machine while in production or temporarily stop production and resolve the cause of defects

[4] Box Sealer (manual and automatic) – manual sealers seal the box by hand while a machine is used for automatic sealing

[5] Box Stacker – the stacker places the boxed items in the pallets to be placed in the stock area, ready to be transported; for the bulk pack, the stacker lifts a box that weighs about 2.5 kgs; for the auto-bagging, he/she lifts a box that weighs about 2.6 kgs.

Job/Worksite Analysis Guide

The job/worksite analysis guide identifies problem areas within a particular area or worksite. Before collecting data, the analyst has to observe the worker, the task, the workplace and the surrounding guide the analyst in using other, more quantitative tools for collecting and analyzing data.

To initiate the ergonomic evaluation of the jobs enumerated above, the proponents then performed a job/worksite analysis guide to determine which factors, and their corresponding tools, and problem areas to focus on. The job/worksite analysis guide can be found in the appendix.

From the results of the analysis, it can be seen that the analysts have to concentrate on the problem areas namely repetitive lifting and grasping, awkward posture, awkward wrist and shoulder motions and unacceptable noise level.

The analysts then performed the following to evaluate the jobs: CTD Risk Index, General Posture and Task Evaluation Checklist and Workstation Evaluation Checklist.

The CTD Risk Index is then computed to identify which among the jobs is the most risky, injurious and prone to Cumulative Trauma Disorder (CTD). It will also help in identifying poor postures and serves as a design tool for selecting key conditions to redesigning. The Workstation Evaluation Checklist will aid in analyzing the workstations of the workers while the General Posture and Task Evaluation Checklist will aid in the analysis of the performance of the tasks.

RESULTS AND DISCUSSION

General Posture and Task Evaluation

The first evaluation tool used is the General Posture and Task Evaluation Checklist. This checklist has been modified as the proponents see fit for the assessment of the said tasks. Table 1 shows the results for each task.
Table 1 shows which among the tasks is problematic with regards to posture and task. It can be seen that bulk packing, auto-bagging, manual sealing and box stacking are the most problematic among the tasks. Automatic sealing is the least problematic because the worker is only feeding the box to the sealing machine. Inspection, meanwhile, is not as problematic as the other tasks since the worker is not subjected to excessive bending and twisting as the other four.

Table 1. General Posture and Task Evaluation Checklist Results

POSTURE EVALUATION	TASKS					
	Bulk packing	Auto-bagging	Manual Sealing	Automatic Sealing	Inspection	Box Stacking
forward bending	✓	✓	✓	✓	✓	✓
twisting of the trunk	✓	✓	×	✓	✓	✓
sudden movements or jerks	✓	✓	✓	✓	×	×
changes in posture	✓	✓	✓	×	×	✓
excessive reaches	×	✓	✓	✓	✓	✓
TASK EVALUATION	**Bulk packing**	**Auto-bagging**	**Manual Sealing**	**Automatic Sealing**	**Inspection**	**Box Stacking**
static muscle exertions	×	×	×	×	×	×
long duration of static exertions	×	×	×	×	×	×
materials and tools not w/in normal working area	×	×	×	×	×	×
tasks carried out above shoulder level	×	×	×	×	✓	✓
tasks carried out below knuckle height	✓	×	✓	×	✓	✓
lifts performed quickly without knees bent	✓	✓	✓	×	×	×
no breaks allowed during shift	×	×	×	×	×	×
Total Score (# of checks)	6	6	6	4	5	6

Workstation Evaluation Checklist

The next evaluation tool used is the Workstation Evaluation Checklist. The result of the evaluation is shown in the appendix. Two workstations are evaluated: Standing and Sitting. For the standing workstation, only the inspector has one cross mark since the inspector is originally to be seated but most of the time the inspector is standing.

The most poorly designed workstations among the tasks are that of manual sealing and case stacking since they got three cross marks and no check marks (check=positive). The manual sealing task has a problematic workstation since the worker has no permanent workstation. By this, we mean that the manual sealing of boxes is done on the floor and the worker is bent the whole time he/she is performing the task. The back angle of the worker -- between 45º and 90º -- is terrible for the back, more so that this is sustained for eight hours of work.

The workstations of the automatic sealing, auto-bagging and bulk packing are relatively acceptable. But there are some problem areas that need to be addressed in these workstations too. The analysts observed that the workstation layouts for the auto-bagger and automatic sealing are not properly designed which causes much of the awkward bending and twisting motions of the workers in this area. The depth and height of the bin where the bagged diapers accumulate while the packers stuff them into a box is low with respect to the height and reach of the worker. The bin looks like Figure 1.

Figure 1. Bin at a working height where the worker has to bend to reach a far object
Source: Kroemer et al, Ergonomics: How to Design for Ease and Efficiency (Fig. 11-17, p 540)

The top view of the workstation for auto-bagging and automatic sealing can be seen on the figure below. The two circles on both sides of bin represent the auto-baggers. The boxes are placed on their sides.

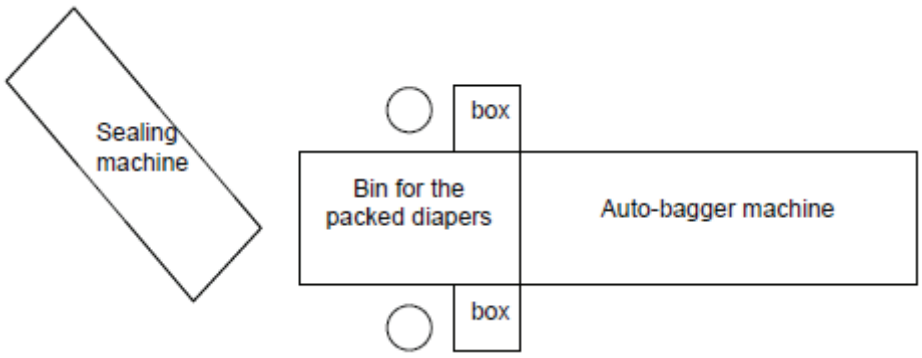


Figure 2. Top View of the current workstation for auto-bagging and sealing

The machine-packed diapers falls on the deposit from the machine and the packer grabs them and stuffs them into a box. And since the speed of the worker in packing is imposed by the process, bending and twisting motions becomes more unavoidable as the worker tries to hasten his/her packing to avoid bottleneck or excessive accumulation of packed diapers in the deposit area.

The single sealing machine placed to the sides of the workers working on the auto-bagger is also not properly situated which causes a lot of awkward twisting motions for the worker. The sealing process looks like this:

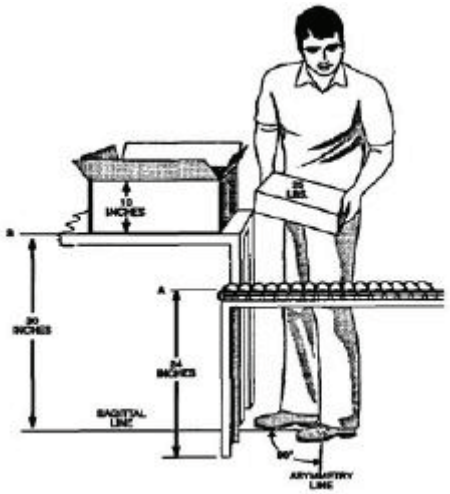


Figure 3. Layout of Work Area for Packaging
Source: Waters et al, Applications Manual for the Revised NIOSH Lifting Equation (p 80)

Meanwhile, for the on-line inspection workstation, there is also a problem with the posture and chair provided for the inspector while working. The chair doesn't have a backrest and a footrest that is large, stable, and adjustable in height and slope. And most of the time, the inspector is standing while he/she randomly inspects Product H and then she bends every time she selects a diaper to inspect because the opening where she gets the diaper is placed on slightly above the knee level.

It can be concluded that poorly designed workstations are one of the main causes of low back pain complaints of the workers.

CTD Risk Index

The Cumulative Trauma Disorder (CTD) Risk Index is then computed for all the tasks to determine which of the tasks is/are the most prone to CTD. CTD risk analysis sums risk values for all three major causative factors into one risk score. A frequency factor is determined by the number of damaging wrist motions, and then scaled by a threshold value of 10,000. A posture factor is determined from the degree of deviation from the neutral posture for major upper extremity motions. A force factor is determined form the relative percentage of maximum muscle exertion required for the task, and then scaled by 15 percent, the maximum allowed for extended static contractions. A final miscellaneous factor incorporates a variety of conditions that may have a role in CTD causation. For relatively safe conditions, the index should be less than one.

The values of the force determined for each tasked were rough estimates since the analysts don't have the proper tool to measure the forces required for each task. The analysis was based on the observations made by the proponents during their visits in The Company. The table below summarizes the calculations performed for each job. The individual calculations are found in the Appendix.

Table 2. Computed CTD Risk Index for each task

Type of Job	Frequency Factor	Posture Factor	Force Factor	Miscellaneous Factor	CTD Risk Index
Bulk Packing	0.40	0.80	2.33	0.33	1.092
Auto-bagging	0.54	0.90	1.67	0.33	0.965
Manual Sealing	0.45	0.80	1.67	0.33	0.9080
Automatic Sealing	0.3375	0.40	1.67	0.33	0.7543
Inspection	0.55	0.80	1.67	0.33	0.9380
Box Stacking	0.27	0.70	2.13	0.33	0.963

The results show that the most prone to CTD and the most risky task is manual bulk packing. The next most risky job is manual sealing of boxes. It can be seen that most of the manual jobs are riskier than the ones where a machine assists in doing the job. The least risky of them all to CTD is inspection. This is of course expected since the inspector's job is not as physically demanding as the other jobs.

All the jobs, except manual bulk packing, have indices of less than one which means that they are *relatively* safe from CTD. This must be verified by The Company since the values of the force factor which contribute a relatively large value to the computed indices are only rough estimates.

Noise Levels

The production area for Product H has a very high noise level. The source of the noise is the machine itself and there is no way to eliminate this because this means shutting down the machine entirely. All the workers are subjected to noise levels of 90-91dB the entire eight hours of their work. The workers, though, are provided with earplugs for hearing protection. But some of the workers, the analysts observed, do not use this earplugs to protect themselves from this ear-damaging noise level. They are sometimes unmindful of the noise surrounding them.

The earplugs effectiveness is measured quantitatively by a noise reduction rating (NRR). To compute for the reduction in noise level, we use the formula:

New Noise Level = Original Noise Level – (NRR-7)/2

The earplug that The Company provides for its workers has an NRR of 33. The computation for the new noise level given that The Company has a noise level of 90dB in the Product H

production area is 77 dB, which is lower by thirteen decibels. But typically, in a real-world setting, with hair, improper fit, etc, the NRR value is going to be considerably lower.

The possible outcome for the workers who don't use their earplugs while at work is hearing loss. As the exposure time increases, especially where higher intensities are involved, there will eventually be impairment in hearing. Nerve deafness is due most commonly to excess exposure to occupational noise. Individuals vary widely in their susceptibility to noise-induced deafness.

CONCLUSIONS AND RECONNENDATIONS

After evaluating the manual handling practices in The Company using the three tools and observations, the most problematic tasks are manual sealing and both packing tasks (automatic and bulk packing). These tasks have bad workstation designs and they entail excessive bending and twisting motions. Manual sealing is particularly awkward because the worker is bent most of time, the back angle being 45º to 90º.

The workstations of the on-line inspector and the auto-bagging process (both packing and sealing) are found to be in need of redesigning to fit the worker to the workstation. Another thing that can be identified with the workplace design is the distances of the equipment or machines or tools from the worker. It should be within the reach of the worker and should be designed or laid out such that awkward movements and postures will be minimized, if not eliminated entirely.

We said earlier that workers switch over jobs during the 8-hour shift. This is a good thing because it will minimize worker fatigue from doing a single, sustained task. And it is also very flexible in that once bottlenecks occur in the packing of diapers, the others can help to remedy it.

For the auto-bagging task, The Company should reconsider redesigning the depth and height of the bin. They could also provide a chair for the auto-baggers so as not to tire the workers easily fromstanding for long periods of time. They can also opt to add another worker to assist in the sealing of the boxes so that the auto-baggers will not do the dual task of packing and sealing concurrently.

We propose a redesigned workstation for the auto-bagging process (packing and sealing) which can be seen at the figure below. This alternative requires that The Company buys another sealing machine (which is costly). In this workstation, the auto-baggers still do the sealing of the boxes.

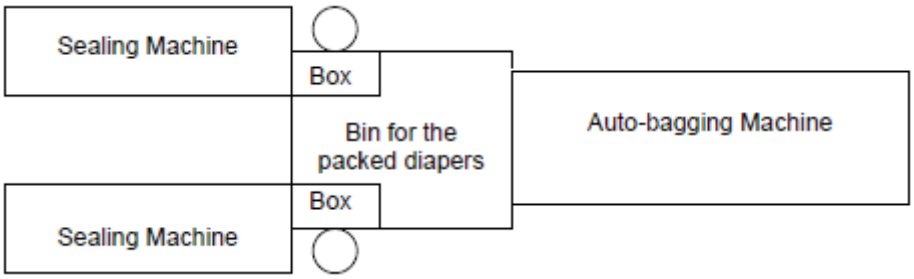


Figure 4. Proposed layout of workstation for auto-bagging process (option 1)

A cheaper alternative is for The Company to hire another worker that is tasked solely to do the automatic sealing of the boxes. He will get the boxes from both auto-baggers. This will avoid excessive bending and twisting motions for the auto-baggers and this could also prevent bottlenecks in packing since they will only concentrate on their task. The workstation design for this can be seen on the figure below. The baggers should be provided with comfortable chairs (with a back rest and an adjustable foot rest).

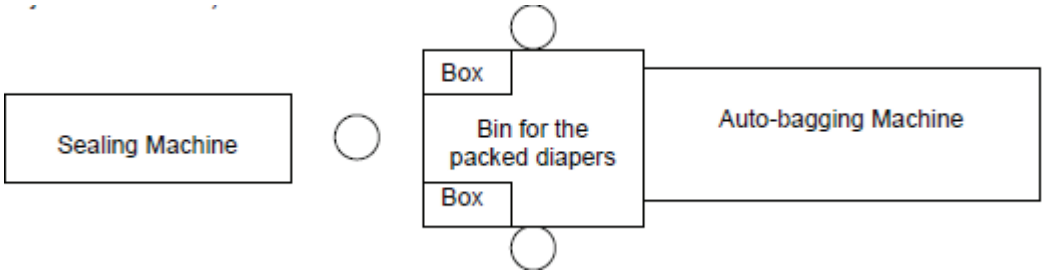


Figure 5. Proposed layout or workstation for auto-bagging process (option 2)

For the on-line inspector, he/she should also be provided with a comfortable chair (with a back rest and an adjustable foot rest) that is placed near the opening where he/she gets the diaper for testing. It is not advisable to redesign the height of the opening because it is dependent on the positioning of the huge machine. To place the opening higher means redesigning a big part of the machine. For the manual sealing task, The Company should provide a table where the sealer can prepare and seal the boxes. This will eliminate the excessive bending brought about by the current manual sealing practice.

REFERENCES

Books

1. Alexander, David C. and Pulat, Babur Mustafa. Industrial Ergonomics Case Studies. 1991. Industrial Engineering and Management Press. USA.
2. Kroemer, Karl, Kroemer Henrike and Kroemer-Elbert, Katrin. Ergonomics. How to design for ease and efficiency. 2nd ed. 2001. Pearson Education Asia Pte Ltd. Philippines.
3. Niebel, Benjamin and Freivalds Andris. Methods, Standards and Work Design. 11th ed. 2004. McGrawHill. Singapore.

Websites

1. Manual Handling Assessment Booklet. Retrieved from Health and Safety Executive Web Site: http://www.hse.gov.uk/pubns/indg143.pdf
2. Manual Handling Assessment Chart Tool. Retrieved from Health and Safety Executive Web Site: http://www.hse.gov.uk/msd/mac/
3. Manual Handling Risk Assessment. Retrieved from Australian Risk Services Web Site: http://www.ausriskservices.com.au/manual_risk.htm
4. Technical Guide for the Evaluation and Prevention of Risks associated with Manual Load Handling. Retrieved from Ministerio De Trabajo Y Asuntos Sociales Web site: http://www.mtas.es/insht/en/practice/g_cargas_en.htm
5. The Long History of OSHA's Ergonomics Effort. Retrieved from Commonwealth of Virginia Worker's Compensation Program Web Site: http://www.covwc.com/lcarticles/archives/000012.php
6. Applications Manual for the Revised NIOSH Lifting Equation. Retrieved from Department of Health and Human Services, Centers for Disease Control and Prevention Web Site: http://www.cdc.gov/niosh/pdfs/94-110.pdf

APPENDIX

Appendix A.
Work-related Muskuloskeletal and Soft Tissues Disorder (MSD's) in the company

Musculoskeletal and Soft Tissue Disorder	April	May	June	July	August
Infection					
a. lower extremity	1		1		
b. upper extremity	2	2			2
c. others					1
Trauma					
a. lower extremity		1		1	
b. upper extremity		1	3	2	
Low Back Pain	5		1	22	
Muscoskeletal Pain					
a. lower extremity			1		1
b. upper extremity					1
c. lower back					
d. upper back					1
Total	8	4	6	25	6
Total Illnesses Treated/Encountered	101	75	192	220	194

Appendix B.

Job/Worksite Analysis Guide (Biebel and Freivalds, 2004)

Job/Worksite Analysis Guide

Job/Worksite:		Analyst:	Date:	
Description:				
Worker Factors				
Name:			Gender: M F	Height: Weight:
Motivation: High Medium Low			Job Satisfaction: High Medium Low	
Education Level: Some HS HS College			Fitness Level: High Medium Low	
Personal Protective Equipment: Safety Glasses Hard Hat Safety Shoes Ear Plugs Other:				
Task Factors				***Refer to:***
What happens? How do parts flow in/out?				*Flow Process Charts*
What kinds of motions are involved?				*Video Analysis, Principles of Motion Economy*
Are there any jigs/fixtures? Automation?				
Are any tools being used?				*Tool Evaluation Checklist*
Is the workplace laid out well? Any long reaches?				*Workstation Evaluation Checklist*
Are there awkward finger/wrist motions? How frequent?				*CTD Risk Index*
Is there any lifting?				*NIOSH Lifting Analysis, UM2D Model*
Is the worker fatigued? Physical workload?				*Heart Rate Analysis, Work-rest Allowances*
How long is each cycle? What is the standard time?				*Time Study, MTM-2 Checklist*
Work Environment Factors				***Work Environment Checklist***
Is the illumination acceptable? Is there glare?				*IESNA Recommended Values*
Is the noise level acceptable?				*OSHA Levels*
Is there heat stress?				*WBGT*
Is there vibration?				*ISO Standards*
Administrative Factors				Remarks:
Are there wage incentives?				
Is there job rotation? Job enlargement?				
Is training or work hardening provided?				
What are the overall management policies?				

Appendix C.
Workstation Evaluation Checklist (Niebel and Freivalds, 2004)

WORKSTATION EVALUATION CHECKLIST

-	TASKS					
Sitting Workstation	**Bulk packing**	**Auto-bagging**	**Manual Sealing**	**Automatic Sealing**	**Inspection**	**Case Stacking**
1. Is the chair easily adjustable according to the following features:	NA	NA	NA	NA	×	NA
a. Is the seat height adjustable from 15 to 22 inches?	NA	NA	NA	NA	×	NA
b. Is the seat width a minimum of 18 inches?	NA	NA	NA	NA	×	NA
c. Is the seat depth 15 to 16 inches?	NA	NA	NA	NA	×	NA
d. Can the seat be sloped ±10° from horizontal?	NA	NA	NA	NA	×	NA
e. Is a back rest with lumbar support provided?	NA	NA	NA	NA	×	NA
f. Is the back rest a minimum of 8 x 12 inches in size?	NA	NA	NA	NA	NA	NA
g Can the back rest be moved 7 to 10 inches above the seat?	NA	NA	NA	NA	NA	NA
h. Can the back rest be moved 12 to 17 inches from the front of the seat?	NA	NA	NA	NA	NA	NA
i. Does the chair have five legs for support?	NA	NA	NA	NA	×	NA
j. Are casters and swivel capability provided for mobile tasks?	NA	NA	NA	NA	×	NA
k. Is the chair covering breathable?	NA	NA	NA	NA	NA	NA
l. Is a footrest (large, stable, and adjustable in height and slope) provided?	NA	NA	NA	NA	✓	NA
2. Has the chair been adjusted properly?	NA	NA	NA	NA	×	NA
a. Is the seat height adjusted to the popliteal height with the feet flat on the floor?	NA	NA	NA	NA	×	NA
b. Is there approximately a 90° angle between the trunk and thigh?	NA	NA	NA	NA	✓	NA
c. Is the lumbar area of the back support in the small of the back (~ belt line)?	NA	NA	NA	NA	NA	NA
d. Is there sufficient legroom (i.e., to the back of the workstation)?	NA	NA	NA	NA	✓	NA

3. Is the workstation surface adjustable?	NA	NA	NA	NA	×	NA
a. Is the workstation surface roughly at elbow rest height?	NA	NA	NA	NA	✓	NA
b. Is the surface lowered 2 to 4 inches for heavy assembly?	NA	NA	NA	NA	×	NA
c. Is the surface raised 2 to 4 inches (or tilted) for detailed assembly or visually intensive tasks?	NA	NA	NA	NA	×	NA
d. Is there sufficient thigh room (i.e., from the bottom of the work surface)?	NA	NA	NA	NA	✓	NA
4. Is sitting alternated with standing or walking?	NA	NA	NA	NA	✓	NA
Standing Workstation						
1. Is the workstation surface adjustable?	×	×	×	×	×	×
a. Is the workstation surface roughly at elbow rest height?	✓	✓	NA	NA	NA	NA
b. Is the surface lowered 4 to 8 inches for heavy assembly?	NA	NA	NA	NA	NA	NA
c. Is the surface raised 4 to 8 inches (or tilted) for detailed assembly or visually intensive tasks?	NA	NA	NA	NA	NA	NA
2. Is there sufficient legroom?	✓	✓	NA	✓	✓	NA
3. Is a sit/stand stool (adjustable in height) provided?	×	×	×	×	✓	×
4. Is standing alternated with sitting?	×	×	×	×	✓	×
Number of checks (sitting workstation)	NA	NA	NA	NA	6	NA
Number of X's (sitting workstation)	NA	NA	NA	NA	13	NA
Number of checks (standing workstation)	2	2	0	1	3	0
Number of X's (standing workstation)	3	3	3	3	1	3

Appendix D.
CTD Risk Index (Niebel and Freivalds, 2004)

Job Title:	Machine:	Date:
Job Description:	Dept:	Analyst:

Cycle Time (in sec):		1
#Cycle/Day	2a	3
#Parts/Day (if known)	2b	
#Handmotions/Cycle		4
#Handmotions/Day		5
Frequency Factor (5 divided by 10, 000):		

(Circle appropriate condition)	Points			
	0	1	2	3
Working Posture	Sit	Stand		
Hand Posture 1: Pulp Pinch	No	Yes		
Hand Posture 2: Lateral Pinch	No	Yes		
Hand Posture 3: Palm Pinch	No	Yes		
Hand Posture 4: Fingers Press	No	Yes		
Hand Posture 5: Power Grip	Yes	No		
Type of Reach	Horizontal	Up/Down		
Hand Deviation 1: Flexion	No	Yes		
Hand Deviation 2: Extension	No	Yes		
Hand Deviation 3: Radial Dev.	No	Yes		
Hand Deviation 4: Ulnar Dev.	No	Yes		
Forearm Rotation	Neutral	In/Out		
Elbow Angle	= 90 °	≠ 90 °		
Shoulder Abduction	0	< 45 °	< 90 °	> 90 °
Shoulder Flexion	0	< 90 °	< 180 °	> 180 °
Back Angle	0	< 45 °	< 90 °	> 90 °
Balance	Yes	No		
Total Points For The Conditions:				6
Posture Factor (5 divided by10):				

Grip or Pinch Force Used on Task	7	lbs.	9 Divide 7 by 8
Max Grip Pinch Force	8	lbs.	
Force Factor (Divide 9 by .15) =			

(Circle appropriate condition)	Points			
	0	1	2	3
Sharpe Edge	No	Yes		
Glove	No	Yes		
Vibration	No	Yes		
Type of Action	Dynamic	Intermittent	Static	
Temperature	Warm	Cold		
Total Points for the Circled Conditions:				10
Miscellaneous Factor (divided 10 by 3):				

CTD Risk Index = 0.3 x (Frequency + Posture + Force Factors) + 0.1 x (Miscellaneous Factor)

CTD Risk Index = 0.3 x (+ +) + 0.1 x ( ) =

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

BENCHMARKING IN HIGHER EDUCATION

Jerzy Woźnicki, Polish Rectors Foundation, Górnośląska 14, 00-432 Warszawa, +48226210972, frpfund@mbox.pw.edu.pl, marzenagemb@wp.pl

Mariusz Luterek, PhD, Institute of Knowledge Society, Górnośląska 14, 00-432 Warszawa, +48226210972, Mariusz.luterek@gmail.com

Iryna Degtyarova, PhD, Oles Honchar Dnipropetrovsk National University, Haharin Avenue, 72, 49010 Dnipropetrovsk, Ukraine, +380678640410, irenkadnepr@ukr.net

ABSTRACT

Purpose: *Nowadays higher education (HE) meets a number of challenges, global, systemic and local: international competition, competition between public and non-public sectors, competition inside the sectors, growing expectations of the market, population decline, insufficient funding, etc. Higher education institutions (HEIs) must be effective to succeed in research, to provide best academic practices and high quality of studies.*
The purpose of the paper is to present the concepts and results of Program "Benchmarking in HE" conducted by the Polish Rectors Foundation.
Methodology: *Benchmarking is crucial for the whole HE system as the method of searching for best practices that enables the achievement of the best results by learning from the others, using their experience and collaborating with them. To be appropriate to HE system, research methodology includes external benchmarking and benchmarking of processes. Also open method is used, so the project beneficiary is the entire system of Polish HE.*
The benchmarking system applied by PRF monitors a wide range of quality and efficiency characteristics of Polish HEIs.
Findings: *Research program "Benchmarking in HE" studies and evaluates Polish HEIs performance through comparative institutional learning approach providing them with crucial information, promoting wider environmental networking, increasing efficiency and improving their international competitiveness, etc. The benchmarking research program consisted of 5 projects that can be grouped into studies aspects (e-learning, quality assurance systems, studies flexibility, National Qualifications based on European Qualification Framework and managerial ones (university governance). Each project results in a summary report providing not only analytical survey, but also practical recommendations.*
Value: *Benchmarking being a part of good governance principle in HE is valuable research both in Poland and internationally (e.g. European Benchmarking Initiative). Our benchmarking program boosts quality of Polish HE system, university strategic profiling and performance improving for ensuring the life-long-learning principles in Poland.*

PURPOSE

Nowadays higher education (HE) meets a number of challenges at global, local and systemic level: international competition, convergence of public and non-public sectors, competition inside the sectors, growing expectations of the labour market, population decline, insufficient funding, etc. All those factors are becoming increasingly important catalysts for the situation in higher education. Their impacts will depend on the performance of the HEIs; the international position and prestige may be a prerequisite for the successful acquisition candidates and entering the local market with various educational offers.

The ongoing implementation of the Bologna Process in Europe, including Poland, prompts comparisons with international competitors and efforts to match their standards, while also opening up to the European market to Polish higher education institutions, whether public or non-public, especially the more renowned ones and those which are already gearing up towards European expansion. The competitiveness of Polish HEIs should be significantly boosted by the comparable quality of their curricula contents, providing best academic practices and high quality of studies, comparable levels of education process achieved thanks to ECTS, diploma supplements and evaluation performed with modern management tools [1].

Due to external dynamic changes in the academic environment the efficiency of the adjustment processes in tertiary education requires, on the one hand, to provide the autonomy of higher education institutions in order to ensure the ability to solve problems effectively on their own, and on the other hand, to equip the minister responsible for higher education with tools enabling him to regulate and supervise the higher education system. Both of these conditions are now met in Poland by the Act on Higher Education [2].

However, it is essential to provide rectors with professionally compiled and maximally comprehensive governance-related information creating more opportunities for successful development of the HEIs in competitive higher education environment. Taking into account the trends and processes at the international level, it is expected that the academic institutions – in order to be successful in the European higher education and research area – will have to be both slow in changes in some areas, and dynamic and profound in the others. The harmonization of such activities in higher education is a challenge for university managers.

One of the ways ensuring evaluation of university performance, diagnosis of the institutional strengths and weaknesses, priorities and specific targets definition as well as being a tool for boosting the university competitiveness is the use of benchmarking methods in higher education.

It's worth to mention that academic benchmarking is declared a strategic tool for university management in a number of European documents:

• Document of European University Association – The Lisbon Declaration – Europe's Universities beyond 2010: Diversity with a Common Purpose*: Governments are urged to benchmark progress against target levels set in relation to both autonomy and funding of universities. Universities will strive to reinforce further leadership and strengthen professional management*.

• Communique of Ministers responsible for Higher Education of European countries – London Communique: Towards the European Higher Education Area: responding to the

challenges in a globalised world: *Priorities for 2009: (...) Data collection: we recognize the need to improve the availability of data on both mobility and the social dimension across all the countries participating in the Bologna Process.*

Benchmarking has emerged in the sphere of business and it has been widely used in industry, finance, transport, retail, services, etc. aimed at quality improvement, discovering work optimizing ways. In Europe, the use of benchmarking as a tool for improving performance both in the private and public sectors has also been supported by the European Commission (DG Enterprise) for more than ten years Benchmarking initiatives were started in the late 1990s such as a benchmarking group on competitiveness, a European Benchmarking Forum and a High level Group on Benchmarking. A Benchmarking Coordination Centre was also established to provide support with data and resources. In 1998 the Great Britain Commonwealth Higher Education Management Service published a research paper „Benchmarking in Higher Education" having particular reference to the higher education of the United Kingdom, Europe, Australia, and North America.

The first EU-funded benchmarking project "European Benchmarking Initiative in Higher Education" was conducted in 2006-2010 and implemented by four partner organizations: the European Centre for Strategic Management of Universities (ESMU), the Centre for Higher Education Development (CHE), the International Centre for Higher Education Management (ICHEM), University of Bath and the Institute of Education (IoE), University of London. The Initiative was designed to help modernize higher education management and to promote the attractiveness of European higher education. The European Commission's view was the benchmarking would be a modern management tool to progress with institutional reforms, increased operational efficiency and the capability for innovative changes to adapt to new challenges in their environment [3].

In the framework of this EU-project a number of papers and books were published, including „Practical guide on Benchmarking in European Higher Education" (2008), and „A University Benchmarking Handbook. Benchmarking in European Higher Education" (2010).

In 2010 the new on-line benchmarking research project named "Global Research Benchmarking System" (GRBS) was started by United Nations University International Institute for Software Technology and the Centre for Measuring University Performance. In 2012 the research covered higher education establishments in Asia-Pacific, the USA, Canada and Europe (27 EU-member states plus Norway and Switzerland).

Following to European trends, benchmarking researches on the national level were held in some European countries and in the USA, Australia, etc. In Poland for the first time benchmarking in higher education on broader scale was used by Polish Rectors Foundation (PRF)[1] within the Program "Benchmarking in higher education", which is being carried out since 2007. Thus, *the purpose of this paper* is to present the concepts and results of research PRF program mentioned above in the area of education and training.

[1] Polish Rectors Foundation working together with Institute of Knowledge Society has been evaluated by Polish National Rectors Conference (CRASP) as a leading think-tank in research into HE in Poland.

METHODOLOGY

Benchmarking is crucial for the whole HE system as the method of searching for best practices that enables the achievement of the best results by learning from others and use their experience. Benchmarking is based primarily on the identification of best practices and their creative adaptation, which excludes the possibility of copying. The direct purpose of this method include: better processes identification, comparing with others, identifying strengths and weaknesses on the background pattern, learning from others, and boosting working practices. Indirect objectives of benchmarking are development of management skills, overcoming reluctance to ideas generated outside the institution, increase of students' satisfaction and competitive advantage [4].

Based on the criteria of subject benchmarking can be subdivided into internal and external (which can be competitive and general). Internal benchmarking is used in large organizations with complex organizational structure. Due to the specificity of the "Benchmarking in higher education" Project, we have selected the method of external benchmarking, comparing different higher education institutions.

From the point of view of the goal criteria, benchmarking can be: of results (comparison of the results gained in any subject sphere), processes (comparing procedures and processes occurring in the institution), and strategic (comparing operations at the strategic level). In the Program "Benchmarking in higher education" we are using benchmarking of processes.

Benchmarking can also be carried out using two methods: closed and open one. Closed method is used for a specific group of entities, often paying a fee for the opportunity to participate in the survey, and aims to increase their individual competitiveness. This means that beneficiaries of the benchmarking are only the organisations participating in the survey (and only them have access to its results). In our Program we are using the open method. In this case, the university group voluntarily participates in the research, and are not subject to any fees. Findings of the survey are publicly available, however in anonymised version. As a result, the main beneficiary of the project is the entire system of higher education, and the research is carried out to improve its competitiveness (and not only selected organisations).

The benchmarking system monitors Polish higher education institutions based on a variety of criteria. A wide range of relevant quality and effectiveness characteristics are taken into account, having to do with the current state of the institutions, their tasks and resources, strategy and competitiveness, performance and development perspectives, both domestically and in relation to European higher education institutions [5-7].

Data are gathered through all available channels of information. Specifically, the data are taken from publications by relevant Polish and foreign institutions, from online sources as well as from materials provided by HEIs based on special agreements relating to the benchmarking system [8,9]

Research carried out within the program "Benchmarking in higher education" is conducted with the use of questionnaires available electronically for the respondents in system KWERO, developed specifically for the Program. This system includes a central repository of data, which holds all the data needed to carry out the benchmarking process.

The surveying system KWERO allows differentiation of applications concerning many different issues: publishing surveys, further working with them, completing survey by proper respondents, surveys verifications by participants of steering committee experts, and so on.

There are 4 types of applications in the system:

- the client application - allows access to the database (filling in questionnaires, review of results, etc.);
- the analyst application - allows to define questionnaires, export of data and support the process of filling questionnaires;
- the administrator application - manages users access rights;
- the content manager application that allows publishing new content and structuring the site.

Access to specific functionalities of the system is determined on the basis of a system positions (roles) and permissions. The system differentiates several groups of users with different activity rights (e.g. users, analysts, administrators).

Data input into the system is mainly held by filling in the electronic users surveys and also by placing the data available from external sources. Completed questionnaires are stored in the database after approval by a data entry supervisor [10].

FINDINGS

Research program „Benchmarking in HE" studies and evaluates Polish HEIs performance through comparative institutional learning approach providing them with crucial information, promoting wider environmental networking, increasing efficiency and improving their international competitiveness, etc.

Therefore the program aims are to develop and launch a benchmarking system providing public and non-public higher education institutions as well as other interested organizations (such as institutions conducting rankings) with advanced governance-relating information. It is also important to respect the principle of access confidentiality, allowing to detect the factors affecting the competitiveness of stakeholders: universities and their associations, consortia, networks, universities, etc. with regard to international relations.

The benchmarking research program consists of 5 projects that can be grouped into 2 types:

Group 1. Studies issues:

1) Benchmarking of e-learning processes (31 participating universities)
2) Benchmarking of processes related to internal quality assurance systems (33 participating universities),
3) Benchmarking of processes of studies flexibility (32 participating education establishments),
4) Benchmarking of processes related to the implementation of the National Qualifications Framework (48 participating universities).

Group 2. Managerial aspects:

1) Benchmarking of process of university governance to improve productivity and competitiveness - management control (37 participating education establishments)

Each project results in a summary report providing not only analytical results but also practical appliances and recommendations.

In this paper we will discuss some findings from benchmarking of processes related to internal quality assurance systems and benchmarking of processes of studies flexibility.

1. Benchmarking of internal quality assurance systems

1.1. Context and goals

The Bologna Process, which from the beginning at its foundation has been closely associated with the issue of lifelong learning, entered a new stage with the adoption of the Recommendation of The European Parliament and of the Council of 23 April 2008 on the establishment of the European Qualifications Framework for life long learning (EQF).

The formal objective of the EQF is to establish a common European system of relating of the various countries' national education (qualification) systems to a common reference framework and accordingly facilitating mobility between them. EQF has revolutionary significance in the word „qualification" that means that the factor for comparing national systems will not be the input criteria, describing the content of the curriculum and requirements for staff and a learning process, so-called learning outcomes: the scope of actually acquired knowledge, skills, and so called soft skills – attitudes, the acquisition of which can be associated with a given level of education. Such approach obviously means a huge change in the way providing research and information on the quality of education, and the implementation of appropriate quality assurance system is essential for entry of the university into the qualifications framework system.

The research related to the advancement of quality assurance and reasons for application of this approach was of innovative character. The main difficulty stemmed from the fact that structured set of rules for the creation and operation of such systems were not refined in Poland. The authors faced with a challenging task of measuring the level of advancement of a very diverse set of internal quality assurance systems in HEIs, implemented at different times, focused on achieving different goals and, what is crucial, usually introduced without awareness or taking into account of the requirements of the adopted by Poland obligations related to the implementation of the Bologna Process.

1.2 Results

The results of this research, conducted in 2008, showed that all Polish universities have established the rules (e.g. in the Statutes or Regulations) on the number of learning groups, but at the same time, however, only 64% of institutions regulate the ratio of students to teachers, and 85.7% - the number of graduates conducted per a promoter in a given academic year. Particular procedures were also introduced defining the bases that are periodically reviewed and changed (93% of responses).

It's interesting, that 14% of institutions did not provide rules on the form of a thesis (monographic, experimental, etc.), and 7% - its format.

All universities have declared conducting systematic surveys of students, analysis of their results and their dissemination of among the university staff. Our research showed, that there are strong differences between HEIs in the form of collecting those data (electronically - only 57% of universities) and the way in which evaluation sheets are being prepared (again, only 57 % of institutions committed to the professionals). It could be assumed that the HEIs collecting data in the form of paper only, applying unprofessional questionnaires are not able to properly analyze the collected data.

The mass character of contemporary tertiary education makes the need for mechanisms to promote attitudes of special commitment in the teaching process, and their introduction and activity certainly is an important part of quality assurance systems. The responses to the questions on those issues in the survey to a large extent confirm the formal and declarative support for involvement of teaching staff into educational activities. The majority of universities declared that the outcome of the assessment of university professor only to a relatively small extent, influences the final assessment of his work. Universities, however, usually have a system for defining people with the great achievements in teaching.

Both the currently binding legal regulations and the recommendations clearly indicate the need for an external evaluation of the quality assurance system as a condition for the credibility of declarations applied by the universities in particular procedures and mechanisms. By the Law universities in Poland are subjected to control of Polish Accreditation Commission (OAC) . However, as our research shows accreditation obtained outside PAC is not that common. The research revealed that 28.6% of HEIs had not received any accreditation of this kind, while one of the universities had got 25 accreditations.

Flexible design of study programs and ongoing adjustment to the needs of the wider external environment is one of the most important manifestations of the fulfillment by the university of its social mission. Our results confirmed the generally known fact that Polish universities have small, but still growing flexibility of programs. The deeper analysis, however, considers the case of two or three schools offered a very large number of new fields of study and / or specialty running since the academic year 2005/2006 (from 65 to 69).

All universities participating in the survey responded positively to the questions on the existence of collegiate bodies engaged into the plans and programs of study, and certainly they comply with the truth, because by law the programs and plans of studies conducted at universities are approved by the collegial bodies.

Polish HEIs have already experienced the effects of international competition (significant drain of prospective students), and in the coming years, awareness of the need to build the competitive position not only at the national level but also internationally, will be a necessary condition for their proper functioning. In this context, it is interesting that 42.9% of HEIs declared that in their development plans and training programs they address the international models and benchmarks.

The next important factor influencing the range of programs and ensuring the quality of its implementation in the coming years will be the new organization of training requirements resulting from the introduction NQF and the need to ensure the reliability of the declared learning outcomes. The way to achieve this objective and the external acceptance of the

program offer by candidates for studies and employers, will be transparency of programs and procedures created with the support of external stakeholders. Thus, interesting and relevant to the assessment activities in these areas is the declaration of more than 50% of universities seeks for such support.

The mobility of students and the internationalization of the university is one of the flagship objectives of the Bologna process. The survey revealed that the universities appreciate the significance of the mobility on both a domestic and international level. In fact, only one HEI reached the rate of 5% students participating in the exchange programs between universities, but actually low activity of students in terms of participation in international seminars and schools has been observed.

Analyzing the efficiency of search and recruitment of foreign students we found that it is hard to consider all universities participating in the study. Two leaders are the medical HEIs, where the situation is quite different from the universities outside this sector. Our conclusion was, that in the future, with a considerable interest, this kind of HEIs should be analyzed separately. Perhaps it would be advisable in this case further to differentiate the universities in the survey according to their specific sector.

A small number of HEIs declaring their joint diplomas with foreign universities (28.6%) confirms the existence of systemic problems in the development of such initiatives.

The proper and wide use of ECTS could be an important indicator of the effectiveness of internal quality assurance processes. As research demonstrated, the majority of Polish universities implemented it on the initial stages, often doing it in formal way and considering as an additional administrative requirement than for process improving and optimizing the curricula and syllabi.

Periodically made assessment of the implementing of the Bologna process indicates more or less satisfactory progress. Remembering that an essential prerequisite for the introduction of two-cycle was promotion of the horizontal and vertical mobility of students and we should highly evaluate the information obtained from the survey, which shows that in many universities introduction of this system significantly created the conditions for such mobility. At the same time, a considerable difference in answers demonstrates the value of such a specific benchmark for positioning university in terms of advancement of the „bolonization" of the education process and thus creating of a new quality.

Taking into account the requirements of university responsibility for the credibility of the declared learning outcomes, the collected information on documenting, monitoring and maintenance of the system and its accessibility for different groups of stakeholders appeared to be valuable. This study was the first attempt to develop a method of determining the measures to enable benchmarking processes related to internal quality assurance systems in higher education. At least a few factors makes this task very difficult. Firstly, the issue of internal quality assurance systems in the majority of Polish universities still remain rather innovation than routine action. Second, the educational institutions have never received external support in developing of such systems. Thirdly, the economic conditions and changing legal framework does not encourage so far to take a long-term and systematic

measures for the quality of education and support of these activities effort to provide adequate logistical support.

2. Benchmarking of processes of studies flexibility

2.1. Context and goals

The problem of flexibility of studies was identified as especially interesting during the research conducted in 2008. Furthermore, since 2008 a lot of innovations have been introduced to Polish higher education system, and thus it was important to analyze those changes in the context of previously obtained data.

The flexibility of the studies is based, generally speaking, on the existence within it the certain extent of freedom, allowing its functioning more effectively than its failing. The flexibility of the study system is its gradable feature: in this regard we can speak of a more or less flexibility in the educational system, as well as the elasticising. Flexibility is a multidimensional feature of the education system: determining the degrees of autonomy may in fact appear in different elements of the system.

Studies flexibility means flexibility of the structure of the studies systems, the flexibility of the programs and the course of study. In the first case, the system provides a possibility to choose the level of qualification obtained at the end of the training, the possibility of design learning paths during the study, and the possibility of reducing curriculum.

Studies flexibility must provide a correspondingly wide range of elective subjects individualizing process of studying (for all students) and the procedure to create individual study programs that meet the minimum requirements for learning outcomes. Each subject should be related to the program (the content) and a number of attributes to enable efficient and reliable creation of individual programs. The set of such attributes include:

- number of hours of study divided into various forms of teaching,
- the number of credits assigned,
- a list of required preceding courses (the predecessor),
- a list of similar themed courses (courses are formally equivalent and that can't be chosen alternatively if student passed the exam),
- a form of assessment,
- the nature of the subject from the point of view of curriculum requirements.

The use of thematic classes when formulating the curriculum requirements is that the set of thematic classes, corresponding to the areas of knowledge important from the point of view of the completeness of the education, and then for each of these classes is determined by the minimum number of credits that a student must pass (in addition, may also be a specific set of compulsory subjects in this class). Requirements relating to particular thematic classes are supplemented by a general requirement to obtain a certain number of credits for all years of study together - are summed points assigned to all the classified objects.

The creation of thematic classes enables students to do the overview of the program, as well as foster:

- definition and consistent use of common terminology and conceptual apparatus of the objects belonging to the same class;
- coordination of the implementation of the content and form of subjects belonging to the same class, in particular the reduction of unintended redundancy (the same content in multiple subjects) and development issues of under-represented in the curriculum;
- the interaction of departments dealing with related subjects, and operating under different organizational units (departments, institutes, HE establishments).

The flexibility of the course of study, which is an important element of the studies flexibility, includes the opportunity to study according to an individual plan of study in subsequent semesters and the possibility of accounting the student achievement (using ECTS) in periods longer than one semester. Both of these solutions help students to adjust their charges in particular study periods, and thus, the pace of study to their needs and abilities.

The main objective of this study was to illustrate the rate of flexibility at the universities operating in early 2011, under the Law on Higher Education in 2005, just before the implementation of the National Qualifications Framework. 32 Participating HEIs sent questionnaires for 208 basic organizational units (mostly – faculties).

2.2. Results

As we can see from the data many HEIs do not provide mechanisms to prevent duplication of content of elective subjects. The problem appears to be much larger at the universities (67%) than at technical universities (30%). The lack of such a mechanism could lead to violations of the assignments of credits to student achievement and a waste of financial resources allocated to education.

The vast majority of surveyed HEIs (90%) allow students to change the direction of the study during the period of their education. The data also showed that the idea of continuing education and lifelong learning (LLL) is still met with limited understanding: other than postgraduate courses and specialized forms of this training are offered by only 7-8% of the surveyed universities.

The results also allow to assume that the structure of curricula is very often determined by the structure of the teaching staff, the curriculum traditions and / or infrastructure limitations rather than the result of a deeper optimization of learning outcomes that these programs are designed to provide. Only partially the outcomes can be justified by the existence of the education standards and the belief that they are sufficient to systematize the content scheme. The situation is better at technical universities.

One of the most interesting findings was that high percentage of respondents offer training in macro-fields (9%), unique (11%) or interdisciplinary studies (10%). The corresponding figures for the universities (12%, 22% and 14%) are significantly higher than for technical institutions (9%, 1% and 7%).

Concerning quality issues, data obtained from answers to questions about the number of ECTS credits for compulsory courses (83%) and elective ones (14%) indicate how rigid generally are the 1st-cycle programs offered by the surveyed HEIs. Likewise, the 2nd-cycle study provided by responding universities are only slightly more flexible (20% subjects chosen by the students). It is even more surprising, since the studies of 2nd level are supposed to be integrated into the research and Master thesis' topics should be related in some way to research projects carried out by the academic staff

The curriculum of the 1st-cycle education dedicated to especially gifted students are only slightly more flexible than programs for all students, with the appropriate indicators, designated for universities (16%) are slightly worse than the average (28%), and the indices determined for the technical university (29%) are slightly better. In the case of the second cycle programs, curriculums dedicated especially to gifted students are generally much more flexible (54% ECTS for elective subjects) than obligatory programs for all students. It turns out, however, that it does not appear to be true in the case universities (only 21%).

In general our research showed that Polish HEIs are embracing opportunities introduced by implementation of NQF. Since first wave of surveys in 2008 a lot has changes in the area of studies – universities are more used to the idea of Bologna Process, however some of them are more ready for the upcoming reform (especially for the freedom of defining study programs on their own) then others. That's why Polish Rectors Foundation has decided to conducts third wave of surveys - benchmarking of processes related to the implementation of the National Qualifications Framework, which is currently at its final stage.

VALUE

The Program has provided us strong analytical data and informational characteristics of different HEIs for new findings concerning positioning of Polish HE, more successful grouping, internal and external university rankings. The research discovered a kind of map of HEIs using criteria for quality of studies and quality of management that is critically essential for education as a system and studying process, as well as for the strategy of Life-Long-Learning development in Poland.

Benchmarking of HE in Poland is valuable research both in Poland and internationally. The benchmarking boosts competitiveness of Polish HE system, university strategic profiling and performance improving.

REFERENCES

1. Woźnicki, J. (2010). *2010-2020 Development Strategy for the Higher Education System. The Academic Community's Proposal*. Paper presented at the IMHE General Conference *Higher Education in a World Changed Utterly: Doing More with Less,* OECD Conference Centre, Paris, France.
2. Woźnicki, J. (2009). *The University as an Institution of Public Domain: the Polish Perspective,* UNESCO-Cepes, European Centre for Higher Education.
3. Benchmarking in European Higher Education // www.education-benchmarking.org
4. *Backgroud, definitions and approaches of benchmarking*. European Benchmarking Initiative (EBI) in Higher Education Symposium, Bruksela 2007.

5. Nazarko, J.; Kuźmicz, K. A.; Szubzda–Prutis, E.; Urban, J. (2009). *The General Concept of Benchmarking and its Application in Higher Education in Europe*. Higher Education in Europe, vol. 34, no. 3–4, pp. 497–510.
6. Woźnicki Jerzy [ed.]:*Assumptions concerning development of management information system in HEIs* (in polish). Polish Rectors Foundation (Monographs Series), Warszawa 2007
7. Woźnicki, Jerzy [ed.]: *Benchmarking in Higher Education System* (in polish).
8. Polish Rectors Foundation (Monographs Series), Warszawa 2008.
9. University of Sydney (2011). *Benchmarking* [online]; [available: 10.02.2011r.]. Retrieved from http://www.sydney.edu.au/learing/quality/benchmarking.shtml#benchmarking.
10. University of Tasmania (2010). *Report on the University Policy Benchmarking Project: Implications for the University of Tasmania*, April, 2010 [online]; [available: 12.01.2011]. Retrieved from http://www.utas.edu.au/__data/assets/pdf_file/0003/42951/
11. Policy–Benchmarking–Project–Report.pdf.
12. Woźnicki, Jerzy [ed.]: *Benchmarking in Higher Education System. Selected Problems* (in polish). Polish Rectors Foundation (Monographs Series), Warszawa 2012

BIOGRAPHICAL

Professor, PhD, DSc in Electronics Engineering Since 1973 he has been working in Faculty of Electronics and Information Technology of Warsaw University of Technology where he passed by all levels of academic career from assistant to full professor. His scope of research activity covers electronics and the issues connected with knowledge society and knowledge based economy.

In the years 1996-2002 he was the Rector of the Warsaw University of Technology.

Until now he has performed the duties in many prestigious scientific organizations inter alia as the member of the Presidential Board of the Polish Section SPIE, Currently he is the President of the Polish Rectors Foundation and the Director of the Institute of Knowledge Society.

Mariusz Luterek, PhD, is an associate professor at Warsaw University (Institute of Information Science and Book Studies). Since 2004 he closely works with Institute of Knowledge Society (IKS) and Polish Rectors Foundation (PRF), where he participated in many projects in the area of higher education, e.g. “Benchmarking in higher education”, “Strategy for Development of Higher Education in Poland 2010-2020”. Since 2012 he is Scientific Secretary at IKS.

Iryna Degtyarova, PhD, is an associate professor at Oles Honchar Dnipropetrovsk National University (Faculty of Ukrainian and Foreign Philology and Study of Art), and a Vice-Chairman of Dnipropetrovsk Oblast Council of Young Scientists. Her scope of research activity covers linguistics and higher education policy in Ukraine and EU. Since 2012 she has closely worked with Polish Rectors Foundation (PRF), now she is a holder of PRF scientific scholarship.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

BRAND AND CORPORATE IMAGE OF A SPORT ORGANIZATION AS A FACTOR OF BUILDING LOYALTY

Agnieszka Rak, Strategic Management Department, Faculty of Economics, Wroclaw University of Economics, Poland, agnieszka.rak@ue.wroc.pl, rak.agnieszka@gmail.com, +48 501 793 391

ABSTRACT

Purpose:*The aim of this paper is to highlight the importance of focusing on customer loyalty on exaple of Polish sport organisations which neglect this area in their marketing strategies. For members of sport organisations who provide a balanced healthy lifestyle or fans and supporters who are a part of a TV or stadium audience sport means strong emotions, love for the game, competition and values they share. Sport organisations give their customers opportunities to practise their beliefs and engage in rituals that develop and strengthen connectivity to their ideologies and the brand, too (Head et al., 2012, p. 209). It is also proofed that corporate reputation may effect satisfaction and loyalty of consumers (Chun, 2005, p. 91). Strong brand and the good reputation have become an important beneficial attribute of an organisation nowadays (Davies et al., 2010, p. 530). When, on the other hand, poor performance of the organisation (or an athlete or a whole team in case of sport industry) may destroy its reputation and cause poor self-esteem not only of employees or members but most importantly of customers (fans and supporters) (Arnett et al., 2003, p.92). Fans can be also a public relations mechanism who spread the word through word-of-mouth (Hopwood, 2010, p. 140). That is why sport organisations should concider their fans as customers for whom brand and organisational image are factors strenghtening loyalty that also play important part of their lives.*

Design/methodology/approach: *Customers (also fans of Polish football teams) were sampled (N=150), with qualitative and quantitative results suggesting that there are many factors influencing reputation of Polish football teams what builds (often a negative) an image of the whole discipline in Poland.*

Findings: *The research revealed that even though football is the most popular sport among Polish fans, even those loyal fans do not share only positive opinions of their favourite teams (also in case of management). In their opinion football clubs do not focus as much as they should on customer satisfaction, which does not attract potential customers.*

Originality/value: *Most of researches focus on business performance, financial stability of sport organisations, and effectiveness of sponsoring or media attention in Poland. There is almost none attention paid on fans and supporters as consumers. The study shows an importance of implementing business strategies in polish sport organisations that focus more on customer, building loyalty and attracting customers. Managers of those organisations should concentrate on customers as much as they focus on sport results. They should consider the game and a team as a product (or service) that has to be presented on the market properly.*

Keywords: image, brand, reputation, sport, organisation, loyalty

INTRODUCTION

Football is the most popular sport discipline in Poland. According to results of a research in run annually by ARC Rynek i Opinia (2013, p. 6) almost 60% of people in Poland are football fans (38% are volleyball fans, 38% ski jumping fans and 29 are boxing fans). Football has a strong influence on Poles (brings values of fair play, desire for physical activity and becoming a sportsman, brings people together) also in case of purchase decisions (buying sponsors products or product offered by the club or team, watching and attending games, etc.). Strong emotional bonds between fans and their favourite discipline, team or a sportsman is what distinguishes sport on the market of all other goods and services. The mechanism of creating those relationships is very important for sport organisations. Fans identify themselves with an organisation (its values, qualities, interests, origins, tradition, etc.) and became ambassadors of its brand (Hopwood, 2010, p. 140). The importance of creating bonds between company and consumers is emphasised nowadays. The desired partnership between an organisation and its stakeholders leads to mutual trust and loyalty, that strengthen its position on a market (Morrison and Wilhelm, 2004, p. 1690). It is said that one of best and most successful marketing strategy is the one focused on maintaining and increasing level of involvement and loyalty of fans and participants (Kontogianni *et al.,* 2011, p. 15). Those relationships are created through displaying and promoting the brand of a product (team, sports man, stadium, event) or the entire organization constantly and consistently, and it often leads to loyalty. Strong brand is a very important asset of an organisation because is a carrier of values and ideas desired by consumers for enriching their lives. People, fans too, surround themselves with brands that became a fulfilment their lives or even personality.

The aim of this paper is to present how both brand and corporate image are important in a process of creating loyalty between sport organisations and their customers (fans). Power and Hauge (2008, p. 125) suggest “our tastes in brands are seen as social tools and indicators that work alongside a host of other symbols, objects, and activities as weapons and reflections of our identities and aspirations”.

Brand in sport

Brand is defined by American Marketing Association as the name, design, symbol or any other feature that identifies one seller's product or service as distinct from those of other sellers (AMA Dictionary). It is a tool of identification of the company and its offer on the market, and in the minds of clients it becomes a subjective image, which is called brand image. Brand image is described as “the perception of a brand in the minds of persons and is a mirror reflection (though perhaps inaccurate) of the brand personality or product being” (AMA Dictionary). It stands for what people believe, their thoughts, feelings and expectations towards a brand.

Both brand and its image make an offer real and enable to distinguish from the competition by proofing a quality and source. A positive brand image is important factor in consumer choices in purchasing process, because it makes those decisions easier to make. From the point of view of the company it contributes to acquiring new clients, caring about present ones, which determines the acquisition or maintenance of a strong market position. The brand is an integral part of the organization that constitutes a promise concerning the offered

features, functions and value of a given product or service (Mruk and Chłodnicki, 2008, p. 13). A strong brand is characterized by its familiarity and recognition by consumers, perceived quality, loyalty, as well as its visibility on the market. Brands functioning on the market become a kind of social glue that attracts and concentrate customers around them. Consumers search for brands that complement their lives with values, emotions, giving the status of consumption, which affects their lifestyle.

A special case of the brand is the one related to sports. It can be a brand of sports team (club), organisation, event, coach, product, professional league, equipment, facility or television programme, etc. This means that the concept of "brand in sport" is a broad definition and may identify commercial and social (non-profit) entities that offer services and products that satisfy needs in the scope of sport and recreation. What distinguishes the brand in the business of sport is the strength of its impact and ability to influence on emotions, as well as passion and commitment that unite fans/consumers by creating strong ties between them (Babiak and Wolfe, 2009, p. 722).

A strong brand can be characterised with five main attributes, which are: brand awareness, brand image, perceived brand quality, consumer loyalty and other brand assets (Witek-Hajduk, 2011, p. 40). Therefore, a strong brand is characterized by its familiarity and recognition by consumers, perceived quality, loyalty, as well as its visibility on the market. It constantly is influenced by changes taking place on the market and in the socio-economic environment of consumers and organisation itself. This means that to maintain a strong brand, an organisation has to manage and support relationships between the brand and consumers (loyalty) and take care about elements like image, quality and awareness, which are all related to performance of the organisation. Different aspects are important for consumers in purchase decision process. They may consider (Kuś, 2011, p. 161):

– the external appearance of people and place providing services and their image (hairstyles, clothing, interests, lifestyles, successes, products used and opinions of sportsmen as well as design, appearance, history, comfort, safety of a stadium, gym or court),
– the opinions of other consumers (ideologies, believes, customs of other fans, supporters or members),
– feelings as to direct contact with the company (experienced through meeting sportsmen, attending the game, contacting sport organisation, ticket or product purchase),
– promotional activities of the company (advertisements, memberships, merchandising, hospitality).

The convergence of those elements, therefore, also associations connected with the brand, determines its cohesion, which affects the unique brand image. Brands that have unchangeable external attributes over time (logo, colour, slogans, etc.) have a chance to permanently take root in consumers' awareness. This means that the consistency and durability of an image reinforces the familiarity of a brand and its strength (Gwinner and Bennett, 2008, p. 413). Fans become extremely attached to team symbols, colours and arms (they often brand themselves with “team” tattoo) so they do not accept any changes.
When a brand is recognised, known and accepted even by those, who despite not using it are aware of it, it is perceived as a market leader that achieves success, offering products or services of high quality. In such a situation the brand becomes something expected through its image and creates demand. Today, the consumption of goods, and mainly the values,

which they provide through its brand, is what connects people. Numerous examples of "consumer communities" can be identified that are integrated around the brands of specific goods and services, where buyers establish ties among each other through common interests, preferences and exchange of opinions and experience. A particularly active place of consumers jointly celebrating a brand is social networking services and events organized by companies for their customers (so-called "brandfests") (Avery, 2012, p. 149). The development of social networks depends on the activity of consumers and the need for exchanging information between them. While the organization of events by companies is a tool for building trust and loyalty of clients towards a brand.

Image and reputation of sport organisation

Image may be described as outsider's (fan, participant, client, partner, competitor etc.) perceptions of the organisation (Lahdesmaki and Siltaoja, 2010, p. 209). American Marketing Association Dictionary (AMA Dictionary) defines image as "consumer perception of a product, institution, brand, business, or person that may or may not correspond with reality or actuality". The concept of reputation is wider because if is a synthesis of the opinions, perceptions and attitudes of an organisation's stakeholders including employees, customers, suppliers and investors and community (Chun, 2005, p. 93). As Corley *et al.* (2000, p. 59) suggest, the reputation is a strategic concept which is centered on long-term impressions of the organization that are created corporate images (that exist as actions, media stories, advertisements, annual statements, events, games, publications) that may be intentionally or unintentionally shared by an organisation. Organisation can manage how others perceive it. Managers and academics believe that the image of an organisation (whether or not a company is seen as reputable) affects market performance (Davies *et al.*, 2010, p. 530). It means that having a good image and reputation becomes on of the most competitive advantages nowadays and sport organisations in Poland become more focused on managing it. Poor performance of an organization or in case of sport a team or a player can lead to poor self-esteem of fans, customers, even employees and sportsmen what may influence a corporate image and reputation (Arnett *et al.*, 2003, p.92).

According to Brown, *et al.* (2006, p. 101) there are four main perspectives of how an organisation may be perceived by internal and external stakeholders, which are:

1. Identity: members' and insiders' perception of an organisation. It is an answer to a question: Who we are as an organisation?
2. Intended image: elements and images that organisation desires to be associated with. It is an answer to a question: What does an organisations want others to think about the organisation?
3. Constructed image: values and images that an organisation believes it is associated with in minds of stakeholders. It is answer to a question: "How does an organisation believe it is perceived and associated with?
4. Corporate image or reputation: associations and reputation representing how is an organisation perceived by stakeholders. It is answer to a question: How is the organisation actually perceived by others?

Both image and reputation are influenced, to a certain extent, by the message the organization sends through its actions (the intended organizational image), it also depends on other outside sources (their opinions and attitudes), such as competitors, industry analysts, consumer

activists, the media etc. (Boros, 2009, p. 646). Corporate reputation affects behaviour of stakeholders who are very important for an organisation such as employees (influences retention), customers (their satisfaction and loyalty) (Chun, 2005, p. 91). In a model of customer based corporate reputation presented by Walsh *et al.*, (2009, p. 191-192) there are four factors to be analysed: customer satisfaction and trust which are predictions of a reputation, and loyalty with word of mouth behaviour that are consequences of corporate reputation. That means that organisations have to focus on customer orientation aspects and quality of offered services and products to maintain customer satisfaction and trustworthiness what may lead to loyalty.

Loyalty of sport fans

Loyalty towards a brand is the degree to which consumers maintain a positive attitude in relation to a given brand or organization, they are faithful and willing to buy its products or services, regardless of the changing economic factors, therefore, in a situation where it would be rational to benefit from a competitive offer (Witek-Hajduk, 2011, p. 184). This attitude is the subjective feeling of a given customer and is related to attachment to a given brand. Consumer loyalty towards a brand is defined also as extended trust. Loyal fans are those who hold favourable attitudes toward a sport organisation, recommend it and promote among other people and exhibit repurchase behaviour (Javadein, et al., 2008 , p.4).

Trust is a key value building loyalty of two sides, but maintaining the principle "concentrating activities on customers based on a set of values that place buyers on a pedestal and in the centre of attention" (Gulati, 2008, p. 87). The strength of loyalty towards a brand may arise from (Patkowski, 2010, p. 110):

– the consumer's assimilation of the feeling that a given brand best meets his/her needs and gives him/her unique benefits desired,
– creating an emotional tie between the consumer and the brand being the result of the brand having an impact on the consumer,
– matching the brand image to the personality and expectations of the consumer.

This means that at the moment the consumer makes purchase decisions, he/she subconsciously compares two systems of values - his/her own and that represented by the brand.

Enthusiasm, identification and passion for sports bonds fans (supporters) with sport organisations, teams, players and also other fans by building strong interpersonal relationships through experiencing different but strong emotions together (Hunt *et al.*, 1999, p. 440). Sport organisations give their fans opportunities to practise their beliefs (about a game, rules, fair play, strategy) and engage them in rituals (rooting, chanting, wearing teams' colours, watching game together) that develop and strengthen connectivity to their ideologies (Head *et al.*, 2012, p. 209). Passion and most importantly loyalty towards brands in sport can have an irrational basis because buyers are mainly guided by emotions and acquire products and services related to the brand (team, player, sport discipline, etc.) regardless of their prices, costs incurred or quality offered (Bühler and Nufer, 2010, p. 65). The typical fan will not change a club or player he/she supports over time due to momentary failure or decrease in form (Hopwood *et al.*, 2010, p. 144). The change of preferences, which may happen, is usually condemned by the surroundings and badly seen, and can result from low attachment

and submitting to a fashion for a given discipline, where successes are achieved at a given moment. The more a fan identifies with a team or sports organization, the more it is likely that over time the strong relationship between him/her and the organization or brand will turn into loyalty (Masteralexis *et al.*, 2012, p. 56).

Sport fans spontaneously make purchase decisions based on. Their behaviour on the market may appear irrational as they result from passion, the assessment of their own identity and the brand. From the point of view of behaviour of consumers on the market, fans are unique, because long-term loyalty is something that can be very difficult to achieve on other markets. Furthermore, fans make sure to constantly publicly emphasize their membership and preferences towards a club. Their statements, i.e. (Greenhalgh *et al.*, 2011, p.45): "I often watch, listen to, read about a given sport", "I have been a fan of this sport for a long time", "I know the rules of the game in this discipline" or "I'm interested in this sport". There are three main consumption behaviours typical for sport fans (Gray and Wert-Gray, 2012, p. 276):

- usage – in-person and media-based attendance (attending games, organised events, meetings of fans, rooting, meetings with team or sportsman, watching a game on TV or online)
- responsiveness to product merchandising (purchase of clothing and gadgets with team logo, name or colours, collecting team gadgets, media releases, autographs),
- word-of-mouth communication – fan talking about the team (with other fans, friends and family, encouraging other people to attending games.

However, in order for people to be loyal and willing to represent and promote the brand of a product (team or a sport organisation) it is necessary to awaken their passions through trust towards the brand, and is what the company is responsible for (Lobby, 2012, p. 19). Sport supporters may be divided into two main groups: television audience and spectators in a stadium or arena (Bühler and Nufer, 2010, p. 68). Fans that attend games may be oriented on consumption (they are not loyal to a certain team, because they only want to be entertained, spend their spare time and have fun), discipline (those are loyal and passionate fans, tracking results of their favourite team, analysing tactics and technical aspects) or an event (those are ground hoppers, ultras and hooligans who don't care about the match itself). Sport organisations should know and understand desires of their fans to be able to fulfil them and to build trust and loyalty. They also should decide on which fans they should focus are which are important for them. Fans considered as “ultras” always show support for their favourite team (not only at a stadium), but on the other hand they often discourage those people who are on consumption (with their attitude, vandalism acts and aggression towards competing team) and want to spend their time with friends and family in a friendly and safe place (they also consumers who are willing to buy gadgets, beverages food, and to pay for extra services).

Polish sport organisations are more aware nowadays and start to care more about their fans and members. Some of them focus more on inviting families to the games, condemning acts of aggression. They understand that loyalty of fans of important for them (it brings profits, attracts sponsors, and promotes teams by fans by word-of-mouth marketing). Football teams try to attract their fans and potential customers by offering loyalty programmes. Fans are able to get club cards that let them get discounts and buy tickets for games. The truth is that those initiatives do not build trust and loyalty but rather destroy the brand and lower brand equity. They encourage fans to profit from discounts only (Muller, 2012, p. 13).

Sport is often considered as powerful tool for community building (Warner *et al.*, 2012, p. 1000). It may also yield images of healthy lifestyle that may be distributed among community members. Sport organisations are aware of it and often decide to encourage social responsibility of supporters and participants through activities that involve supporting community or charitable societies (Ratten, 2011, p. 766). That involvement brings benefits and positive effects for both sport organisation (better organisational image, loyalty and stronger relationship with community and fans) and the community (integration, support, awareness, health, patronage intentions of sport consumers, emotional relationship with the sport organisation) (Walker and Kent, 2009, 759).

FINDINGS OF THE RESEARCH

Presented study has a preliminary character. It highlights which factors influence perception of brands of Polish football teams as well as what does loyalty mean for fans. During quantitative research fans of sport organisations (football clubs) were sampled (N=120). Men and women between 20 and 32 years old were surveyed. Those young people represent generation of conscious and independent consumers, for whom sport plays an important element of life.

Almost half (42%) of surveyed fans support specific team usually because it is from the same region or city they live (Take in Figure 1.). Smaller group of people admitted that they are fans because the team succeeds and has excellent sport results (20%) or it is open for cooperation with fans (13%). It is possible that people more often are loyal to local sport teams who they can relate to (they have the same origins, traditions, history, values, relatives used to be members or players, or parents are or used to be fans of). At the same time they show support to a different or even foreign team whose successes, team members, coaches, tactics and skills are outstanding and are in some way a role model. Fans express their loyalty towards a team with strong emotions (with acts of loyalty like: wearing teams colours, having team gadgets at home, in a car in a place visible to others, tattooing their body with team logo, writing posts about the team online, joining supporters organisations) and sometimes it becomes similar to religion (believing that the team is the best one, singing songs with other supporters, joining rituals, fighting for a team). Nevertheless, they admit that they understand that football clubs focus on financial profits the most, and this main goal is followed by entertaining the society, sport education, development of sport and serving society as the least important. According to the findings of presented research, actions taken by football clubs and sport organisations toward communities (also socially responsible activities) are usually local. Even sport organisations run nationwide events, customers (fans) note, take part in and remind those local ones. It is possible that football clubs in Poland focus more on getting involved in local rather than nationwide initiatives because they understand importance and impressiveness of the bonds with local communities or it is due to limited budgets they manage. It is understandable that as members of local communities they focus on solving local problems. In opinion of respondents of the research, focusing on local initiatives is a good direction for sport organisations in Poland. This way football teams may show their respect and build loyalty and strong bonds with fans on values like trust, origin, history and tradition, and that is why they support them locally. The survey revealed that fans believe that social activism of football clubs is a great opportunity for them to improve image among those who are not fans and supporters.

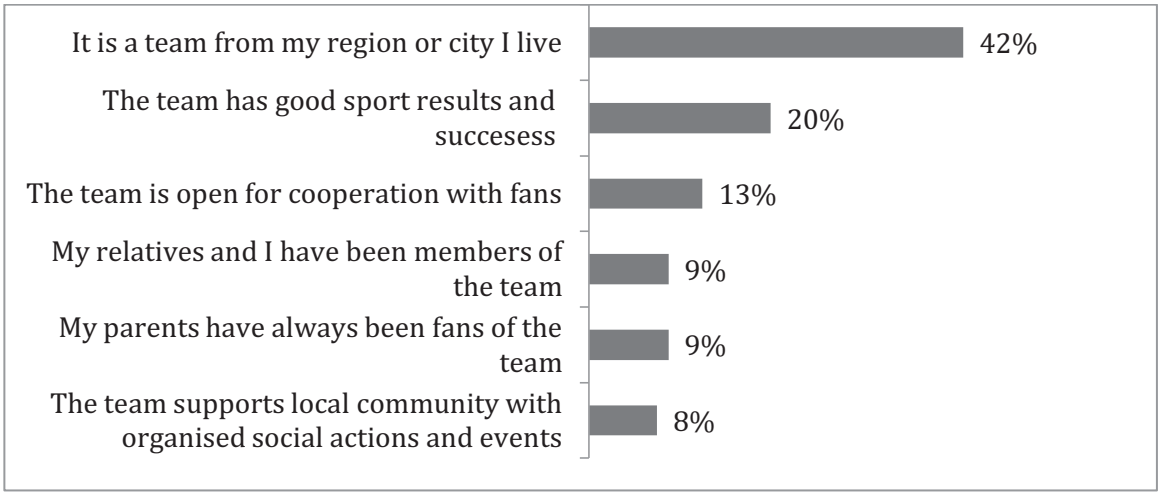


Figure 1. Reasons for supporting specific Polish team

Respondents were also asked about ways they support their favourite football team and were choosing the most suitable statement for them (the statements were representing attitudes of a fans) (compare Figure 2.). Most of interviewed fans support not only Polish teams but also foreign ones. They more often watch games at a stadium than transmissions of games on TV. Study show that in is important for fans to watch and attend games to be able to show their support, integrate with other fans, and to track sport results and meet with the team. Very little group of respondents admitted that supporting the team means for them buying gadgets with team logo and colours. It is surprising because when attending games at the stadium almost all the fans. When analysing what fans attending games wear, it is visible that almost every one of tem wears something with team colours (neckerchief, shirt or a cap). Probably, for Polish fans, having gadgets means not a way of supporting a team but rather a way of showing their affiliation, preferences and origin (people are very often fans of a team from an area where they have grown up).

Figure 2. Ways of supporting a favourite team in Poland

CONCLUSIONS

Reputation of organisation influences minds of both consumers (their satisfaction) and members or employees (willing to stay and support it or leave and change an organisation) (Chun, 2005, p. 91). Customer satisfaction even in sports is very important. The loyalty between a person and an organisation in sport business in not based on sport results but mostly emotions. For sport fans sport results have secondary significance. For them history, origin and personality of a team is more important.

The preliminary research revealed that young Polish people (age 20-32) are willing to express their support for their favourite football time by cheering and watching the game on a stadium. They also watch TV transmissions of teams representing both Polish and foreign football leagues. Supporters are loyal to those teams that have the same origin with a sport organisation they are loyal to. Those fans are emotionally attached to teams not only because of the local character but also because their friends or relatives are fans or used to be members or players of the team. Even though, there is a very strong and unique bond between them and a team, they are aware that those sport teams have commercial character. It may a proof for an assumption that sport organisations should focus more on their loyal supporters (understand them, meet their needs, maintain loyalty and positive associations which are foundations of those bonds).

Managers of sport organisations should find a balance to focus less on gaining new customers (new fans, also oriented only on consumption during an event) and concentrate more on cooperation and maintain loyalty of present supporters. Achieving business goals with succeeding in sports (achieving good sport results) is crucial for sport organisations but it is impossible to do so without long-term customer satisfaction. Fans, supporters and members of sport organisations should truly feel that activities taken by sport organisations are honest and designed for supporting and cooperating with them leaving business goals behind as secondary. Polish football teams should begin to work on their prosocial attitudes, openness to fans desires and needs and to dialogue. All football fans in Poland are often wrongfully treated as hooligans who represent a small group, which acts of vandalism, are often showed and condemned in media. That small group of fans builds a very negative image of all other fans that are focused on spending time in a atmosphere of tolerance, friendliness, safety and fun. Polish football clubs should focus on showing their respect and gratitude to them to gain their loyalty and trust. That change should be a trigger for new strategy of a whole sport organisation, its personality, and as a result corporate image and reputation. Building a brand of an organisation and its corporate image rich in positive values (trust, friendship, fair play, safety, fun, brotherhood, tradition, respect) will bring more and more fans who will show their support and loyalty. Those social bonds will bring both financial and immaterial profits. With that strategy a football team is able to become a responsible member of society, and community members will share reputation of the organisation, support for their actions which will make an organisation and its activities (also sport ones) more permanent and visible on the market. It is also said that organisations should focus more on customer orientation and product and service quality in case of reputation to satisfy customers (fans, supporters, local community) to succeed (Walsh *et al.,* 2009, p. 198). That approach limits costs of searching and building trust with potential customers, while maintaining loyalty and satisfaction of present ones is much cheaper.

REFERENCES

1. AMA Dictionary, American Marketing Association, available at: http://www.marketingpower.com/_layouts/Dictionary.aspx (accessed 12 November 2012).
2. Arnett, D.B., German, S.D., and Hunt, S.D. (2003). "The Identity Salience Model Of Relationship Marketing Success: The Case of Non-Profit Marketing". *Journal of Marketing Vol.* 67, No. 2, pp. 89-105.
3. Avery, J. (2012). "The relational roles of brands". in Peñaloza L. (Ed.), Toulouse N. (Ed.), Visconti L. M. (Ed.) (2012). *Marketing management: A cultural perspective*, Routledge, Great Britain, pp. 147-163.
4. Babiak K., and Wolfe, R. (2009). "Determinants of Corporate Social Responsibility in Professional Sport: Internal and External Factors", *Journal of Sport Management*, 2009, Vol. 23, pp. 717-742
5. Boros, S. (2009). "Identity and Image: The Soul and Face of Organizations" in S. Boros (Ed.), *Exploring organizational dynamics*. Sage: London, Great Britain, pp. 644-654.
6. Brown, T.J., Dacin, P.A., and Pratt, M. G. (2006). "Identity, Intended Image, Constructed Image, and Reputation: An Interdisciplinary Framework and Suggested Terminology", *Journal of Academy of Marketing Science*, Vol. 34, No. 2, pp. 99-106.
7. Buhler, A., and Nufer, G. (2010). *Relationship marketing in sports.* Butterworth-Heinemann: Oxford, Great Britain.
8. Chun, R. (2005). "Corporate Reputation: Meaning and Measurement", *International Journal of Management Reviews,* Vol. 7, No. 2, pp. 91-109.
9. Corley, K. G., Cochran, P. L., and Comstock, T. G. (2001). Image and the Impact of Public Affairs Management on Internal Stakeholders. *Journal of Public Affairs, 1(1),* 53-68.
10. Davies, G., Chun, R., and Kamins, M.A. (2010). Reputation Gaps and the Performance of Service Organizations. *Strategic Management Journal, 31*, 530-546.
11. Gray, G. T., Wert-Gray, S. (2012). Customer retention in sports organisation marketing: examining the impact of team identification and satisfaction with team performance. *International Journal of Consumer Studies*, 36, pp. 275-281.
12. Greenhalgh G. P., Simmons J. M., Hambrick M. E., Greenwell T. C. (2011), Spectator Support: Examining the Attributes That Differentiate Niche from Mainstream Sport, *Sport Marketing Quarterly*, 2011, 20, p. 41-52
13. Gulati R. (2008). "Burzenie silosów czyli jak wywiązać się z przyrzeczenia „nasz klient nasz pan", *Harvard Business Review Polska*, Nr 61, 85-96
14. Gwinner K., Bennett G. (2008). The Impact of Brand Cohesiveness and Sport Identification on Brand Fit in a Sponsorship Context, *Journal of Sport Management*, 22, pp. 410-426
15. Head, G., Jensen Schau, H., and Thompson, K. (2012). "Facilitating collective brand engagement and aborative production through cultural marketing", in *Marketing management: A cultural perspective.* L. Penaloza, N. Toulouse, L. M. Visconti (Eds.)., Routledge: Oxon, Great Britain, pp. 194-211.
16. Hollins B., and Shinkins S., (2009). *Zarządzanie usługami. Projektowanie i wdrażanie*, PWE, Warsaw, Poland.
17. Hopwood, M. (2010). "The public Relations role of fans and supporters' groups", in Hopwood, M., Kitchin, P., and Skinner, J. (Eds.), *Sport Public Relations and Communication.* Butterworth-Heinemann: Oxford, Great Britain, pp. 139-153.

18. Hunt, K. A., Bristol, T., and Bashaw, R. E. (1999). "A Conceptual Approach to Classifying Sports Fans". *Journal of Services Marketing*, Vol. 13, No. 6, pp. 439-452.
19. Javadein, S. R. S., Khanlari, A. and Estiri, M. (2008). "Customer loyalty in the sport services industry: the role of service quality, customer satisfaction, commitment and trust". *International Journal of Human Sciences,* Vol. 5, No. 2., pp. 1-19.
20. Kontogianni, E., Kouthouris C., Berlas, A., and Voutselas, V. (2011). "Involvement and loyalty in recreation swimming in Greece: investigating relatioships«. *International Journal of Sport Management Recreation ans Tourism*, Vol. 8, pp. 13-34.
21. Kuś G. (2011). *Decyzje zakupowe konsumentów a systemy komunikowania*, Wydawnictwo Innowacyjne Novae Res, Gdynia, Poland.
22. Lahdesmaki, M. and Siltaoja, M. (2010). "Towards a variety of meanings – multiple representations of reputation in the small business context". *British Academy of Management,* Vol. 21, pp. 207-222.
23. Lobby M. (2012). "Authentic Competition. Brand Loyalty Established Through Company Image", *SGB Weekly, The Weekly Digital Magazine for the Sporting Goods Industry*, Nr. 1205, 30 available at: www.sgbweekly.com (accessed 21 February 2013).
24. Masteralexis L. P. (Ed.), Barr C. A. (Ed.), and Hums M. A. (Ed.), (2012). *Principles and Practise of Sport Management*, Jones and Bartelett Learning: Sudbury, USA.
25. Morrison A. D., and Wilhelm Jr. W.J., (2004). "Partnership Firms, Reputation and Human Capital". *The American Economic Review*, Vol. 94, No. 5, pp. 1682 – 1692.
26. Mruk, H. (Ed.), and Chłodnicki, M. (Ed.) (2008). *Kreowanie marki w sporcie*, Sport and Business Foundation, Poznań, Poland.
27. Muller, J. (2012). "Chleba, igrzysk, lojalności". in *Loyalty Business Overview 2012.* Krakow: Pallad Media SC, pp. 12-14, available at:www.marketing-news.pl (accessed 12 November 2012).
28. Oblicza polskiego sportu i sponsoring sportowy 2012/2013 (2013) ARC Rynek i Opinia. , available at: http://www.arc.com.pl/image/www/2012_02_02_Oblicza_polskiego_sportu_Sponsoring_Monitor_2012_2013.pdf (accessed 2 March 2013).
29. Patkowski P. (2010). *Potencjał konkurencyjny marki. Jak zdobyć przewagę na rynku*, Poltext, Warsaw, Poland.
30. Power, D. and Hauge, A. (2008). "No Man's Brand—Brands, Institutions", and Fashion. *Growth and Change*, Vol. 39, No. 1, pp. 123-143.
31. Ratten, V. (2011). "Practical Implications and Future Research Directions for International Sports Management". *Thunderbird International Business Review*, Vol. 53, No. 6, pp. 763-770.
32. Walker, M., and Kent, A. (2009), "Do Fans Care? Assessing in Influence of Corporate Social Responsibility on Consumer Attitudes in the Sport Industry". *Journal of Sport Management,* Vol. 23, pp. 743-769.
33. Walsh, G., Mitchell, V. W., Jackson, P. R., and Beatty, S. E. (2009). "Examining the Antecedents and Consequences of Corporate Reputation: A customer Perspective". *British Journal of Management, 20*, 187-203.
34. Warner, S., Dixon, M. A., and Chalip, L. (2012). "The Impact of Formal Versus Informal Sport: Mapping the Differences in Sense Of Community". *Journal of Community Psychology*, Vol. 40, No. 8, pp. 983-1003.
35. Witek-Hajduk M. K. (Ed.) (2011). *Zarządzanie silną marką*, Wolters Kluwer Polska, Warsaw, Poland.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

ROLE OF MONITORING AND CONTROLLING QUALITY IN TQM

Prof Sanjana Brijball Parumasur (Corresponding Author), Discipline of Human Resource Management, School of Management, University of KwaZulu-Natal (Westville Campus), Durban, South Africa,
Tel.: +27 31 260 7176, brijballs@ukzn.ac.za

Dr Patsy Govender, Discipline of Human Resource Management, School of Management, University of KwaZulu-Natal (Westville Campus), Durban, South Africa,
Tel.: +27 31 260 7335, govenderpa@ukzn.ac.za

ABSTRACT

Purpose: *As a result of increasing competition, organizations have realised the importance of using technological advances in bringing about continuous improvement in quality, thereby securing increased customer satisfaction and loyalty as well as sustainable development. This study aims to assess managerial perceptions of the extent and nature of monitoring and controlling quality (competitive benchmarking, continuous monitoring of sources of defects, statistical quality control) that takes place in the organization in efforts to achieve total quality management. Biographical influences on these managerial perceptions are also assessed.*
Design/methodology/approach: *A sample of 202 managers (middle, senior, top) was drawn using a stratified random sampling technique. Data was collected using a pre-coded, self-developed questionnaire whose psychometric properties were assessed using Factor Analysis and Cronbach's Coefficient Alpha respectively. Data was analyzed using descriptive and inferential statistics.*
Findings: *The findings reflect that managers believe that monitoring and controlling quality takes place at a moderate pace in the organization with the greatest focus being on competitive benchmarking, followed by continuous monitoring of sources of defects and lastly, on statistical quality control. The regression analysis, however, indicates that statistical quality control has the greatest impact on monitoring and controlling quality followed by continuous monitoring of sources of defects and then competitive benchmarking.*
Research limitations: *The study was undertaken in a public sector organisation and caution must therefore, be taken to generalize the results of the study to the private sector or any other business environment.*
Originality: *Based on the empirical analysis, since all action plans for monitoring and controlling quality in the organization reflect areas for improvement in bringing about total quality management, a graphical representation is outlined to recommend strategies for enhanced monitoring and controlling of quality and the accomplishment of TQM.*

Keywords: monitoring and controlling quality, competitive benchmarking, continuous monitoring of sources of defects, statistical quality control, statistical process control, total quality management

INTRODUCTION

The continued recognition of quality and quality control is the fulcrum of business leverage, strategic goals and challenges faced by today's competitive work environment. This solution building organizational perspective calls for a review on quality requirements for organizations to secure a place in today's aggressive global markets. Globally, burgeoning literature maps out core and engaging information on managing quality in all spheres of organizational activities. This information flow compels organizational managers to continuously rethink the relevant action plans to monitor and control quality. The inherence of a certain amount of variability is normal. Quality management has set boundaries and the building blocks for competitive challenge and continuous improvement. Quality, a determinant of success is more than a basic either/or proposition of product and service quality needs analysis (Kreitner, 2007). To enhance organizational performance and superior service, the study delves into managerial perceptions of the role of monitoring and controlling quality in efforts to achieve total quality management.

The TQM approach with its strategic intent steers organizations to be effective and efficient (Schultz, Bagraim, Potgieter, Viedge & Werner, 2003), and places strong emphasis on collaborations for process improvement and ultimate customer satisfaction. To win a new customer may take five times more than it does in keeping a present one but the strategic challenge regarding service is to anticipate and exceed customer expectations (Kreitner, 2007). Customers judge products and services, and will favour the ones that reach high standards (Anyamele, 2005). Hence, the key drivers for monitoring and controlling quality are to obliterate deleterious obstacles which have become axiomatic in reflecting how competitive advantage is achieved and how to move into new domains and fuel competitive goals and objectives. Responsibility and accountability for quality processes should be the focus (Dale, van der Wiele & van Iwaarden, 2007).

Employees, considered as assets, deliver quality product or services for organizational performance (Ijaz, Kee & Irfan, 2012). Engaged with these precepts, a spirit of idealism needs to be at the helm to weave commitment and dedication. TQM's key elements entail customer focus, teamwork, continuous improvement and a reduction of reworks, amongst others (Yang 2005, cited in Ijaz, Kee & Irfan, 2012). The five distinct service characteristics portrayed by Kreitner (2007) is direct participation with customers in the production process, immediate consumption of service, the provision of services where and when the customer requires, the tendency for services to be labour-intensive, and for services to be intangible. Whilst less waste, faster cycle times and flexibility are avenues for continuous improvement (Kreitner, 2007), monitoring and controlling quality is the centrefold in business activities. Quality control of a service is to watch it unfold whilst simultaneously evaluating it with the consumer's judgement and the validity of the comparison is the satisfaction level of the customer (McGregor, 2004 cited in Kreitner, 2007). Tools such as benchmarking and control charts are evident features of the long-term drive for continuous improvement (Kreitner, 2007).

High levels of productivity and high quality results in a long-term competitive strength. Deming's work draws on "Shewhart's concept of statistical process control" (Kelemen, 2003:25), whose message to the Japanese is that variability is within any process which is due to special causes and common causes. Special causes are assignable, identifiable and

solvable, whereas common causes relate to "design and operation and only management can eliminate" (Kelemen, 2003:25). TQM and its interconnected practices, such as "statistical process control (SPC), quality circles, benchmarking and business process re-engineering, and ISO 9000 certification" (Yang, Chang, Niu & Wu, 2008:430) are adopted in many industries.

Competitive benchmarking

Benchmarking which involves searching for industry best practices results in superior performance (Belcourt, McBey, Hong & Yap, 2013; Evans & Lindsay, 2005). Benchmarking of processes is as important as the analysis of product and development, and that is a strategic organizational tool that accomplishes organizational goals. This strategic tool enhances transparency (Braadbaart, 2007), and its measurement standard for performance and a best-in-class achievement, amongst others (Punniyamoorthi & Murali, 2006), enables a company to measure their performance against that of the best performing companies in the industry, and assesses how industry leaders accomplish such performance levels. Via benchmarking, the following can be accomplished: a review of processes, practices and systems; motivation for higher performance through targets for improvement; display of comparative data with 'best-in-class organizations' and stimulation of improved ways of operating (Belcourt *et al.*, 2013). A salient point is the focus on 'high-visibility key processes' with the possibility of a high return on investment; hence, the benchmarking practice is encouraged (Dale, van der Wiele & van Iwaarden, 2007). With organizational comparisons, improvement opportunities may emerge. With focus on processes instead of people, a culture of blaming others would be removed.

The level of values for organizations is that after data collection and comparison, the gaps will be obvious as the best organization might have metrics, for example a six-week processing time whereas your organization may process in twelve weeks (Belcourt *et al.*, 2013). Such analysis enables a company to assess performance gaps, which serve as a springboard for setting realistic goals and ensuring continuous creativity, innovation and improvement. Hence, competitive benchmarking equips a company to identify its strengths and weaknesses and those of other industry leaders, and to learn how to integrate the best practices into its own operations in terms of setting targets, developing strategies and engaging in implementation. TQM and benchmarking highlight product quality index with follow-up action for evaluation and TQM emphasizes the correction to reduce defect rates (Jung-Lang-Cheng, 2008). Furthermore, the American Productivity and Quality Centre and the European Foundation for Quality Management are explicitly engaged in promoting and training in benchmarking as an essential approach to achieve excellence (Dervitsiotis, 2000).

The benchmarking technique, a 'breakthrough improvement' and the implementation of best practices is often not enough as the best at certain practices are from diverse areas. This technique needs to be instituted into a company's culture to improve continuously (Dale, van der Wiele & van Iwaarden, 2007).

Monitoring of sources of defects

A defect is a non-conformance on one of numerous possible quality characteristics of an item that causes customer dissatisfaction and may be categorised as a critical defect, major defect

or a minor defect (Evans & Lindsay, 2005; Gitlow, Oppenheim, Oppenheim & Levine, 2005). Zero defects, a performance standard, means mistake-free or error-free (Crosby, 2006), and few quality standards call for perfection. It does not mean that mistakes will not occur, but defects are not acceptable (Crosby, 2006). Crosby's concept of the zero defects theme which is within the framework of his quality absolutes is to 'do it right the first time' by preventing defects instead of finding and fixing them. This concept or performance standard gained popularity (Davies, 2001:224) and refers to quality as conformance to requirements.

A common occurrence is that without clarity, employees will select the performance standard they think will best suit the leader. Inconsistencies on the performance standard will emerge in the quality of products and services. The zero defects concept must infiltrate organization-wide (Crosby, 2006). Evidently, Six Sigma shows acceptance of a few defects (Crosby, 2006). Whilst critical defects need close observation including monitoring and control, minor defects do not as they are still useable. Where quality improvement is the focus, defect detection and inspection on a mass basis is not good enough. In a TQ environment, the aim is to constantly improve processes so that products and services are within the specification range, are of quality and have zero defects.

Furthermore, quality indicates conformance to requirements and not elegance (Evans, 2005), and task completion follows measurements to determine conformance. Quality begins in functional departments (responsible for problems), and not in quality departments. The quality department's task is to measure conformance, report results, and lead the initiative for a positive quality improvement attitude (Evans, 2005). Non-conformance as an expense trails to the cost of quality and thus, managers' attention and corrective action leads to ultimate improvement and recognition of achievement.

Deming places emphasis on quantitative methods, and the difficulty in defining quality is to translate the user's needs into measurable features. Juran's definition of quality is 'fitness for use'. Many scholars with their findings realize that quality management should not result in emasculation and tend to corroborate to the concepts and principles of zero defects. It is critical to align product features and products free from deficiencies and to instil this culture into employees. Meeting customer expectations is Juran's strong viewpoint (Suarez, 1992). Juran and Deming argue that it is futile, if not hypocritical, to exhort a line worker to produce perfection because the extremely large amounts of imperfections are linked to poorly designed manufacturing systems which is beyond the workers' control (Evans, 2005:30-31). Evidently, Juran and Deming see no fruition in encouraging line workers to produce perfection.

The priorities to reach zero defects include: performing to the leader's standards, conforming to the requirements, quality as an absolute, clear quality standards with products and services, errors emerging from poor attitudes, lack of ability and problems in the work environment, quality as the employer's responsibility, and the performance standard must be adopted and made known (Crosby, 2006). Crosby (2006) emphasizes further that zero defects are sound and it always works, and managers need to adopt and publicize this organization-wide. This in-depth information on quality matters offers fertile information and powerful solutions to the piloting of processes and for the ultimate accomplishment of end products.

Statistical quality control and statistical process control techniques

A certain amount of variability will always exist with production processes and this may emerge because of assignable causes (can be discovered and eliminated) or chance causes (cannot be eliminated) (Lakshmi & Ramesh, 2012). The utilization of statistical techniques determines the presence of assignable cause and signals to make a process adjustment to avoid out-of-control situations (Lakshmi & Ramesh, 2012). The authors corroborate that in some instances the control chart techniques were not successful to some extent which may be due to technical reasons but the non-conformance of normality is the main one. The non-parametric methods (easier to conduct) seem more applicable. In their study, Lakshmi & Ramesh (2012) use sign test and run test for application in quality control. They concluded that the non-parametric test can be a hand for a layman before deploying the traditional statistical techniques for the control of quality of materials produced.

Quality control techniques are important in all sectors, including the service industry. Bin Jumah, Burt & Buttram (2012) opine that using Lean Six Sigma in, for example, banking is of benefit, as in using statistical process control (SPC) in trading machines. To cope globally, service industries need efficiency with operational processes. Statistical quality control (SQC) control approaches provide tools, for example, control charts for monitoring processes. SQC was introduced by Deming and Juran who convinced managers in Japan that continuously controlling and improving quality would lead to improved productivity, to new world markets and to survival (Evans & Lindsay, 2005). Walter Shewhart who introduced SQC charts maintains that the process expands beyond inspection to focus on identifying and eradicating the problems in the production processes that cause defects (Evans & Lindsay, 2005). SQC approaches provide tools for monitoring and detection of anomalies and assists employees by keeping 'key quality measurements' in a range that is acceptable. Furthermore, a control chart monitors actual and desired quality measurements for operations that are repetitive.

Furthermore, statistical process control (SPC), a method of fault detection (Yang, Chang, Niu & Wu, 2008) is a methodology for process monitoring to identify special causes of variation and to signal the need to take corrective action appropriately; it gives a rational basis for applying statistical thinking to controlling processes, thereby enhancing consistency of output (Evans, 2005). Failing to implement and operate SPC effectively can hinder an organization's ability to meet product specifications, reduce the cost of production and improve quality, amongst others (Goetsch & Davis, 1994 cited in Yang *et al.*, 2008). Simply, the SPC statistical technique monitors to reduce production variation. Decades have foreseen the use of SPC to improve quality processes and products in quality management (Bergman & Klefsjo, 2003 cited in Bergquist & Albing, 2006). The SPC quality improvement technique quantifies the performance of a process over a period of time. It tracks the process output to ascertain the variation that exists and to determine whether performance targets are met with the process. Control charts, a segment of SPC, aids in tracking the consistent calculation of statistical information and detects changes that are of significance in a process, and with the detection of special cause action it can eliminate the form of variation (Boe, Riley & Parson, 2009).

A salient point is that apart from the manufacturing industry, statistical methods have been utilized in other forms of problems, for example, to understand the needs and behaviour of

customers (Green & Srinivasan, 1978 cited in Bergquist & Albing, 2006). Evidently, statistical methods have 'found applications in service' (Mason & Antony, 2000 cited in Bergquist & Albing, 2006) and this use of statistical methods is also "amplified by the broadened focus of Six Sigma" (Hoerl, 2001 cited in Bergquist & Albing, 2006:962). The comprehension, use and applicability of statistical methods is imperative. Customers may request proof of SPC control from organizations, thereby enabling them to display their ability to deliver quality, which is much needed for survival in a highly competitive corporate environment.

Those concepts that are developed within the process control realms have indicated that close loop systems have superior performance with regard to maintaining the service level requirements (SLR) and "rejecting disturbances than the corresponding open loop systems" (Shaikh & Prabhu, 2009:2786). An advantageous approach to increase performance would be to close the loop between planning and execution. Furthermore, software agents are required to add dual capabilities of monitoring and notification (the detection of discrepancies between planning and execution and indicating alerts) and responding (to determine an appropriate correction action) (Shaikh & Prabhu, 2009). Having a consistent and reliable SPC is important and the tools/techniques form an imperative part of the overall quality management strategy.

Moreover, whilst strategic management concentrates on internal requirements TQM focuses on statistical process control to ensure continuous improvement (Vinzant & Vinzant, 1996). The link between TQM and strategic planning is that strategic planning must be customer driven, and must precede TQM initiatives, and results must be the focus to ensure long-term success.

Aims of the study

This study aims to assess managerial perceptions of the extent and nature of monitoring and controlling quality (competitive benchmarking, continuous monitoring of sources of defects, statistical quality control) that takes place in the organization in efforts to achieve total quality management. Biographical influences on these managerial perceptions are also assessed.

RESEARCH DESIGN

Research approach

The research methodology has been designed to assess the importance of monitoring and controlling quality in order to accomplish total quality management (TQM).

Respondents

The population comprised of middle, senior and top management in a large public sector department in eThekweni (Durban) in South Africa. The population comprised of approximately 400 managers. The sample of 202 subjects was drawn using a stratified random sampling technique to ensure proportionate representation from the strata of the designated groups of interest, that is, managers. According to the population-to-sample size

table by Sekaran (2003), the corresponding minimum sample size for a population of 400 is 196, thereby confirming the adequacy of the sample size for this study. In terms of the composition, 12.9% of the sample consisted of top managers, 32.7% were senior managers and 54.4% were middle managers. In addition, 29.7% of the respondents were 50 years and older, 39.1% were between 40-49 years, and 24.8% were between 30-39 years with only 6.4% being below 30 years. Indian respondents made up 39.1% of the respondents, followed by Whites (34.7%), Blacks (19.8%) and Coloureds (6.4%). In terms of tenure, 24.8% of the respondents worked in the organization for 21 years and over, 16.8% served for 16-20 years, 27.2% for 11-15 years, 21.3% served for a term of 6-10 years and only 9.9% were between 0-5 years in the company. The majority of the subjects have a postgraduate degree/s (40.6%), followed by those who hold a first degree (24.3%), those who have a diploma certificate (16.3%), a postgraduate diploma certificate (10.4%) and 8.4% who have between Standard 8-10 (Grade 10-12). The majority of the subjects were males (85.1%) with only 14.9% being females, thereby indicated the disproportionate percentage of females to males in management. The adequacy of the sample was further determined using the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (0.758) and the Barlett's Test of Spherecity (1429.264, p = 0.000) for the sub-dimensions of monitoring and controlling quality (competitive benchmarking, continuous monitoring of sources of defects, statistical quality control) which respectively indicated suitability and significance. The results indicate that the normality and homoscedasticity preconditions are satisfied.

Measuring Instrument

Data was collected using a self-developed questionnaire consisting of Section A (biographical information) and Section B included items relating to the sub-dimensions of monitoring and controlling quality. The biographical data in Section A was collected using a nominal scale with pre-coded option categories and the items in Sections B were measured using a 5-point Likert scale ranging from strongly disagree (1), disagree (2), neither agree/not disagree (3), agree (4) to strongly agree (5). The questionnaire was formulated on the basis of identifying recurring themes that surfaced during the literature review and the 20 items included in the questionnaire related directly to the constructs being measured (10 items related to competitive benchmarking, 3 items pertained to continuous monitoring of sources of defects and 7 items related to statistical quality control). This ensured face, content and construct validity. Furthermore, in-house pretesting was adopted to assess the suitability of the instrument. Pilot testing was also carried out using 12 subjects, selected using the same procedures and protocols adopted for the larger sample. The feedback from the pilot testing confirmed that the questionnaire was appropriate in terms of relevance and construction.

Statistical measures of the questionnaire

The validity of the questionnaire was assessed using Factor Analysis. A principal component analysis was used to extract initial factors and an iterated principal factor analysis was performed using SPSS with an Orthogonal Varimax Rotation. Only items with loadings >0.4 were considered to be significant and when items were significantly loaded on more than one factor only that with the highest value was selected. In terms of the sub-dimensions of monitoring and controlling quality (Section B), three factors with latent roots greater than unity were extracted from the factor loading matrix. Factor 1 related to statistical quality

control and accounted for 16.17% of the total variance, Factor 2 related to continuous monitoring of sources of defects and accounted for 15.47% of the total variance and Factor 3 related to competitive benchmarking and accounted for 14.63% of the total variance in monitoring and controlling quality to achieve total quality management. The reliability of Section B of the questionnaire relating to the sub-dimensions of monitoring and controlling quality was determined using Cronbach's Coefficient Alpha (Alpha = 0.854). This alpha coefficient indicates a very high level of internal consistency of the items and hence, a high degree of reliability. The reliabilities for the individual sub-dimensions of monitoring and controlling quality were also assessed. Whilst competitive benchmarking (alpha = 0.760) and statistical quality control (alpha = 0.789) reflected strong reliabilities, the inter-item consistency for continuous monitoring of sources of defects (alpha = 0.483) displayed a moderate level of reliability.

Administration of the measuring instrument

The questionnaires were administered over a three month period and respondents could either post the questionnaire in the attached self-addressed envelope or send them electronically to the researchers.

Statistical analysis

Descriptive (means, standard deviations) and inferential (correlation, ANOVA, t-test, Post Hoc Scheffe's test, multiple regression) statistics were used to analyse the quantitative data. The data was captured using Excel (Version 5), processed with Simstat and presented using tabular and graphical representations.

RESULTS

Managerial perceptions of efforts in the organization to monitor and control quality in order to enhance total quality management were assessed in terms of assessing the extent to which the organization engages in competitive benchmarking, continuous monitoring of sources of defects and statistical quality control (Table 1).

Table 1: Descriptive Statistics – Monitoring and controlling quality

		Monitoring and controlling quality			
Statistic		**Overall**	**Competitive Benchmarking**	**Continuous monitoring of sources of defects**	**Statistical quality control**
Mean		3.1729	3.2640	3.2600	3.0157
95% Confidence	**Lower Bound**	3.0887	3.1738	3.1560	2.9058
Interval for Mean	**Upper Bound**	3.2572	3.3542	3.3640	3.1257
Variance		0.354	0.418	0.556	0.622
Std. Deviation		0.5951	0.64660	0.74585	0.78857
Minimum		1.40	1.20	1.00	0.57
Maximum		4.45	4.80	5.00	5.00

Overall, managerial perceptions of monitoring and controlling quality to achieve total quality management is fairly positive (Mean = 3.1729). In this organization the focus on competitive benchmarking (Mean = 3.2640) and continuous monitoring of sources of defects (Mean = 3.2600) are almost equal, followed by statistical quality control (Mean = 3.0157). Against a maximum attainable score of 5, there is room for improvement in each of the sub-dimensions.

Frequency analyses were computed to obtain greater insight into these managerial perceptions. With regards to competitive benchmarking, 65.3% of the managers agreed and a further 5.4% strongly agreed that they find that action plans are developed to ensure improvement. Furthermore, 63.4% of the managers either agreed or strongly agreed that the organization incorporates best practices into its operations in terms of setting targets. However, 12.4% of the managers either disagreed or strongly disagreed that with benchmarking, their organization sets realistic goals. Furthermore, 9.4% of the managers disagreed that their organization incorporates best practices into its operations in terms of developing strategies and another 37.1% were not convinced about this. Also, 9.4% of the managers disagreed that with benchmarking action plans are developed to ensure innovation and another 41.6% were not convinced about this. In addition, 38.7% of the managers were unsure that with benchmarking, action plans are developed to ensure creativity.

With regards to continuous monitoring of sources of defects, 60.4% of the managers agreed and a further 7.4% strongly agreed that by observing, monitoring and controlling sources of defects, the occurrences of defects are eliminated. However, a substantial 64.2% of the managers were not convinced that in the organization, the improvement processes in total quality is continuous so that where applicable the concept of zero defects is maintained.

With regards to statistical quality control, whilst 57% of the managers find control charts to be of importance to establish a state of statistical control, 53% did not find control charts to be of importance to monitor a process to identify special causes of variation and to take correction action when needed and 62.4% did not find them to be important in determining process capability. Furthermore, managers were not convinced that the practice in their organization is to control (65.4%) or improve (65.9%) quality by using statistical quality control charts. Also, 57.4% of the managers did not feel that the tools/techniques used in quality control are an integral part of the overall TQM strategy of the organization.

Hypothesis 1:
The sub-dimensions of monitoring and controlling quality that contribute to total quality management (competitive benchmarking, continuous monitoring of sources of defects, statistical quality control) significantly correlate with each other (Table 2).

Table 2: Intercorrelation – Sub-dimensions of Monitoring and controlling quality

Sub-dimension	Competitive Benchmarking	Continuous monitoring of sources of defects	Statistical quality control
Competitive Benchmarking	1		
Continuous monitoring of sources of defects	0.567 **0.000***	1	
Statistical quality control	0.542 **0.000***	0.388 **0.000***	1

*** p < 0.01**

Table 2 indicates that the sub-dimensions of monitoring and controlling quality that contribute to total quality management (competitive benchmarking, continuous monitoring of sources of defects, statistical quality control) significantly correlate with each other at the 1% level of significance. Hence, hypothesis 1 may be accepted. The implication is that an improvement or change in any one sub-dimension has the potential to impact on the other sub-dimensions thereby, influencing total quality management. The combined improvement of all the sub-dimensions will have a snowballing effect and exponentially contribute to monitoring and controlling quality and hence, the realization of TQM.

Hypothesis 2:
There is a significant difference in the perceptions of managers varying in biographical data (position, age, race, tenure, academic qualification, gender) regarding each of the sub-dimensions of monitoring and controlling quality that have the potential to contribute to total quality management (Tables 3 – 5).

Table 3: ANOVA and t-test - Biographical Variables and Sub-dimensions of Monitoring and controlling quality

Monitoring and controlling quality and sub-dimensions	ANOVA										t-test		
	Current Position		Age		Race		Tenure		Academic Qualifications		Gender		
	F	p	F	p	F	p	F	p	F	p	t	df	p
Monitoring and controlling quality	5.552	0.005*	0.627	0.598	1.381	0.250	1.248	0.292	2.503	0.044**	-1.035	196	0.302
Competitive benchmarking	8.072	0.000*	1.998	0.116	1.327	0.267	1.244	0.294	1.434	0.224	-0.312	195	0.756
Continuous monitoring of sources of defects	0.949	0.389	0.286	0.835	2.500	0.061	0.308	0.872	0.957	0.432	0.773	195	0.441
Statistical quality control	2.443	0.089	0.414	0.743	1.199	0.311	1.608	0.174	2.641	0.035**	-0.165	196	0.869

*** p < 0.01**
**** p < 0.05**

Table 3 indicates that the perceptions of managers varying in position (top, senior, middle managers) regarding monitoring and controlling quality and competitive benchmarking respectively, differs significantly at the 1% level of significance. Furthermore, academic qualifications of managers also significantly influences their perceptions of monitoring and controlling quality and statistical quality control at the 5% level of significance. No other significant biographical influences were noted in Table 3. Hence, hypothesis 2 may only be partially accepted. In order to assess exactly where these significant differences lie, the Post Hoc Scheffe's test was computed (Tables 4 – 5).

Table 4: Post Hoc Scheffe's Test – Current Position and Dimension and sub-dimensions of Monitoring and controlling quality (Multiple Comparisons)

Dependent Variable	**(I) Current Position**	**(J) Current Position**	**Mean Difference (I-J)**	**p**
Monitoring and controlling quality	Top manager	Middle manager	0.412	0.001*
Competitive benchmarking	Top manager	Senior manager Middle manager	0.348 0.533	0.017** 0.000*
*** The mean difference is significant at the 0.01 level** **** The mean difference is significant at the 0.05 level**				

Dimension and sub-dimensions of Monitoring and controlling quality		**Top manager**	**Senior manager**	**Middle manager**
Monitoring and controlling quality	N Mean Std. Dev.	26 3.487 0.459	66 3.223 0.573	110 3.075 0.612
Competitive benchmarking	N Mean Std. Dev.	26 3.669 0.522	66 3.322 0.662	110 3.136 0.621

The mean differences in the Post Hoc Scheffe's Test results (Table 4) indicate that top managers (Mean = 3.487) differ significantly from middle managers (Mean = 3.075) with regards to monitoring and controlling quality. Top managers strongly believe that monitoring and controlling quality occurs in the organization in attempts to ensure total quality management as compared to middle managers. With regards to competitive benchmarking, top managers (Mean = 3.669) differ significantly from senior managers (Mean = 3.322) and to a large extent from middle managers (Mean = 3.136). Top managers' perceptions of competitive benchmarking as a mechanism to bring about total quality management are more positive in comparison to senior managers and middle managers in the organization.

Table 5: Post Hoc Scheffe's Test – Academic Qualifications and Dimension and sub-dimensions of Monitoring and controlling quality (Multiple Comparisons)

Dependent Variable	(I) Academic Qualifications	(J) Academic Qualifications	Mean Difference (I-J)	p
Monitoring and controlling quality	Post-graduate degree/s	Standard 8-10	0.429	0.012*
		Diploma/Certificate	0.253	0.037*
	Post-graduate diploma/certificate	Standard 8-10	0.427	0.035*
Statistical quality control	Post-graduate degree/s	Standard 8-10	0.558	0.011*
		Diploma/Certificate	0.394	0.014*

*** The mean difference is significant at the 0.05 level**

Dimension and sub-dimensions of Monitoring and controlling quality		Standard 8-10	Diploma/ Certificate	Under-graduate Degree	Post-graduate Degree	Post-graduate Diploma/ Certificate
Monitoring and controlling quality	N	15	33	49	82	21
	Mean	2.864	3.041	3.146	3.293	3.291
	Std. Dev.	0.793	0.748	0.437	0.553	0.525
Statistical quality control	N	15	33	49	82	21
	Mean	2.623	2.792	3.009	3.186	3.075
	Std. Dev.	1.101	1.071	0.589	0.702	0.627

The mean differences in the Post Hoc Scheffe's Test results (Table 5) indicate that managers who have post-graduate degree/s (Mean = 3.293) differ significantly from managers who have Standard 8-10 (Mean = 2.864) and from managers who have a Diploma/Certificate (Mean = 3.041) in terms of monitoring and controlling quality in the organization. The results reflect that managers who have a post-graduate degree/s have more positive perceptions about monitoring and controlling quality as compared to managers who have a Diploma/Certificate or Standard 8-10. Furthermore, with regards to monitoring and controlling quality, there is a significant difference between managers who have a post-graduate Diploma/Certificate (Mean = 3.291) and managers who have Standard 8-10 (Mean = 2.864). Clearly, managers who have a post-graduate Diploma/Certificate are more certain that monitoring and controlling quality takes place in the organization in efforts to bring about total quality management as compared to managers who have Standard 8-10.

Table 5 also indicates that with regards to statistical quality control, there is a significant difference between managers who have a post-graduate degree/s (Mean = 3.186) and managers who have Standard 8-10 (Mean = 2.623) and those who have a diploma/certificate (Mean = 2.792). Clearly, managers who have a post-graduate degree are more certain that statistical quality control effectively takes place in the organization in efforts to bring about total quality management as compared to managers who have Standard 8-10 or a diploma/certificate.

Hypothesis 3:
The sub-dimensions (competitive benchmarking, continuous monitoring of sources of defects, statistical quality control) significantly account for the variance in monitoring and controlling quality aimed at achieving total quality management (Table 6).

Table 6: Multiple Regression – Monitoring and controlling quality

Model	R	Adjusted R Square
3	0.882	0.881

Model	Standardised Coefficients Beta	t	p
Competitive benchmarking	0.363	53.948	0.000
Continuous monitoring of sources of defects	0.420	67.542	0.000
Statistical quality control	0.444	73.174	0.000

Table 6 reflects that the sub-dimensions (competitive benchmarking, continuous monitoring of sources of defects, statistical quality control) significantly account for 88.1% of the variance in monitoring and controlling quality aimed at achieving total quality management, although in varying degrees. Hypothesis 3 may, therefore, be accepted. Based on the Beta loadings it is evident that statistical quality control (Beta = 0.444) has the greatest impact on monitoring and controlling sources of defects followed by continuous monitoring of sources of defects (Beta = 0.420) and then competitive benchmarking (Beta = 0.363).

DISCUSSION OF RESULTS

The results (Mean = 3.1729) indicate that monitoring and controlling quality takes place at a moderate pace in the organization with the greatest focus being on competitive benchmarking (Mean = 3.2640), followed by continuous monitoring of sources of defects (Mean = 3.2600) and lastly, on statistical quality control (Mean = 3.0157). Evidently, against a maximum attainable score of 5, there is room for improvement in monitoring and controlling quality in efforts to achieve total quality management with the greatest improvement needed in statistical quality control. Statistical quality control was introduced by Deming and Juran who convinced managers in Japan that continuously controlling and improving quality would lead to improved productivity to 'new world markets' (Evans & Lindsay, 2005). Evans (2005: 298) cautions that since statistical process control needs processes to reflect measurable variation, "it is ineffective for quality levels approaching Six Sigma" but statistical process control is effective for organizations that are in the early phases of quality efforts. Cognizance must be taken of the three applications of control charts:

- the establishment of a state of statistical control,
- process monitoring and signalling when the process goes out of control, and
- to determine process capability (Evans & Lindsay, 2005).

The results also reflect that the sub-dimensions of monitoring and controlling quality (competitive benchmarking, continuous monitoring of sources of defects and statistical quality control) significantly relate to each other at the 1% level of significance. Hence, an improvement in any one sub-dimension of monitoring and controlling quality has the potential to have a snowballing effect and enhance all the other sub-dimensions as well as total quality management. A combined improvement in all the sub-dimensions therefore has the potential to enhance total quality management exponentially. For example, an organization can strive to adopt best practices in benchmarking in attempts to enhance total quality management. Best practices in benchmarking refers to approaches that give outstanding results, are innovative regarding the use of 'technology or human resources', and are recognized by 'customers or industry best practices' (Evans, 2005). Statistical quality control also plays a significant role in ensuring performance.

Based on the philosophy of W. Edwards Deming, the methods of statistical process control, and basic statistics, a system may be designed for effectively benchmarking a performance index (Maleyeff, 2003). However, a standardized system for performance benchmarking does not exist due to the differences among industries with regard to the nature of the benchmarking process and the complex statistical methods that may be involved (Maleyeff, 2003). Statistical process control is imperative for monitoring the process to identify special causes of variation that signals the need to take corrective action when needed (Evans & Lindsay, 2005). However, Six Sigma does indicate that a few defects are acceptable (Crosby, 2006).

With regards to the impact of biographical data, it was found that there is a significant difference amongst employees varying in current position (top, senior and middle managers) in the organization regarding both monitoring and controlling quality and competitive benchmarking at the 1% level of significance. Furthermore, there is a significant difference amongst employees varying in academic qualifications regarding both monitoring and controlling quality and statistical quality control at the 5% level of significance. A similar finding shows that managers without graduate degrees often take courses to equip themselves with methods, techniques and statistical formulae to enhance efficiency and improve quality (CareerPlanner.com, 2013). However, no significant difference was found amongst employees varying in the other biographical data (tenure, gender, age, race) regarding monitoring and controlling quality. Similarly, with regards to monitoring and controlling quality and gender, it was noted that women have entered into every sphere of activity and are performance-oriented; therefore, companies will work towards retaining them irrespective of gender. Furthermore, the relationship between gender diversity and business outcomes is evidenced in the performance of organizations with a more robust mix of women and men in senior management (Pellegrino, D'Amato, & Weisberg, 2011).

RECOMMENDATIONS AND CONCLUSION

A strong recommendation to monitor and control quality is to adopt benchmarking in order to set realistic goals in the organization. Furthermore, it is imperative to implement control charts to indicate its importance in determining process capability. Furthermore, when monitoring sources of defects where quality improvement is the focus, engage in constant improvement processes that ensure that products and services are within the specification range, are of quality and have zero defects. With competitive benchmarking, search for industry best practices that result in superior performance and assess performance gaps, set realistic goals and ensure continuous creativity, innovation and improvement. In addition, with statistical quality control (SQC) and statistics process control (SPC), use SQC and SPC charts to identify and eradicate problems in the production process by taking corrective action. Consistent and reliable SPC ensures consistency of output and is an imperative part of the overall TQM strategy.

With regards to the biographical data, monitoring and controlling quality is influenced by managers' current position in the organization. The finding in this study reflects that the higher the managerial level, the more convinced managers are that monitoring and controlling quality is occurring in the organization. In view of this, it is of utmost importance that managers at lower levels be aware and understand that monitoring and controlling quality would lead to improved productivity as this forms an imperative part of the overall TQM strategy.

Furthermore, monitoring and controlling quality is influenced by managers' academic qualifications in the organization. The finding in this study indicates that the higher the academic

qualifications of managers, the more convinced they are that monitoring and controlling quality is evident in the organization. In light of this, it is important to ensure that managers with lower qualification are given the opportunity to perhaps further their education or attend training courses to fully understand the impact of monitoring and controlling quality on the organization's overall productivity.

In addition, competitive benchmarking is influenced by managers' current position. In this study it was found that the higher the managerial level, the stronger the perceptions that competitive benchmarking is practiced in the organization. In view of this, managers at lower levels must be communicated to and convinced that benchmarking, which involves searching for industry best practices, results in superior performance.

Furthermore, statistical quality control is influenced by managers' academic qualification. In this study, it was found that the higher the academic qualifications of managers, the more convinced they are that statistical quality control is taking place in the organization. Taking this into consideration, it is important to ensure that managers with lower qualifications be equipped with adequate knowledge and perhaps take further studies to understand statistical quality control within the organization as customers may request proof of statistical quality control from the organization.

The aforementioned recommendations relating to monitoring and controlling quality are graphically represented in Figure 1 and when effectively implemented have the potential to ensure total quality management.

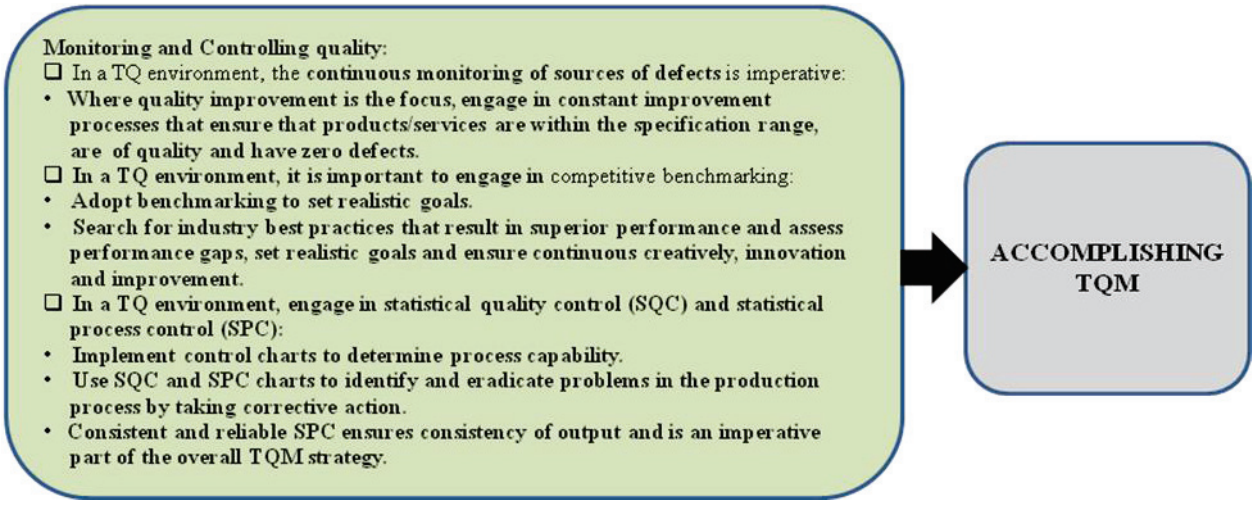


Figure 1: Recommendations relating to monitoring and controlling quality in efforts to accomplish total quality management

The results of the study open many avenues for a fresh perspective of the various facets of monitoring and controlling quality in attempts to enhance total quality management. In particular, it emphasizes the role of competitive benchmarking, continuous monitoring of sources of defects and statistical quality and process control in the evolution of world class organizations. These strategies are imperative for organizations seeking to produce more with less and to design customer centric strategies and fuel their growth objectives.

REFERENCES

1. Anyamele, S.C. (2005), Implementing Quality Management in the University: The Role of Leadership in Finnish Universities, *Higher Education in Europe*, Vol. 30 No. 3-4, 357-369.
2. Belcourt, M., McBey, K.J., Hong, Y. & Yap, M. (2007), *Strategic Human Resources Planning*, Fifth Edition, United States of America: Nelson Education.
3. Bergquist, B. & Albing, M. (2006), "Statistical methods – Does Anyone Really Use Them?" *Total Quality Management*, Vol. 17 No. 8, pp. 961-972.
4. Boe, D.T, Riley, W. & Parson, H. (2009), "Improving Service Delivery in a Country Health Department WIC Clinic: An Application of Statistical Process Control Techniques", *American Journal of Public Health*, Vol. 99 No. 9, pp. 1619-1624.
5. Braadbaart, O. (2007), "Collaborative benchmarking, transparency and performance evidence from the Netherlands water supply industry", *Benchmarking: An International Journal*, Vol. 12 No. 6, pp. 677-692.
6. Bin Jumah, J.A., Burt, R.P. & Buttram, B. (2012), "An Exploration of Quality Control in Banking and Finance", *International Journal of Business and Social Science*, Vol. 3 No. 6, pp. 273-277.
7. CareerPlanner.com. (2008), "Industrial Production Managers", Available at: http://job-outlook.careerplanner.com/Industrial-Production-Managers.cfm [Accessed 25 March 2013].
8. Crosby, D.C. (2006), "Quality Management: Quality is Easy", *Quality Magazine*, January, pp. 58-62.
9. Dale, B.G., van der Wiele, T. & van Iwaarden, J. (2007), Managing Quality, Fifth Edition, USA: Blackwell Publishing.
10. Davies, E. (2001), "The quality gurus", *Engineering Management Journal*, pp. 223-229.
11. Dervitsiotis, K.N. (2000), "Benchmarking and business paradigm shifts", *Total Quality Management*, Vol. 11 No. 4/5, pp. 641-646.
12. Evans, J.R. (2005), *Total Quality: Management, Organization, and Strategy*, Fourth Edition, Canada: Thomson South-Western.
13. Evans, J.R. & Lindsay, W.M. (2005), *The Management and Control of Quality*, Sixth Edition, Singapore: Thomson South-Western
14. Ijaz, A., Kee, D.M.H. & Irfan, S.M. (2012), "Internal customer satisfaction and role of TQM practices", *Far East Journal of Psychology and Business*, Vol. 6 No. 2, pp. 1-14.
15. Gitlow, H.S., Oppenheim, A.J., Oppenhein, R. & Levine, D.M. (2005), *Quality Management*, Third Edition, Boston: McGraw Hill International Edition.
16. Jung-Lang-Cheng (2008), "Implementing six sigma via TQM improvement: an empirical study in Taiwan", *The TQM Journal*, Vol. 20 No. 3, pp. 182-196.
17. Kelemen, M.L. (2003), *Managing Quality: Managerial and Critical Perspectives*, London: Sage Publications.
18. Kreitner, R. (2007), *Management*, Tenth Edition, Boston: Houghton Mifflin Company.
19. Lakshmi, A. & Ramesh, S. (2012), "Statistical Quality Control in Paper Machine – An NP Approach", *European Journal of Economics, Finance and Administrative Sciences*, Issue 50, pp. 143-148.
20. Maleyeff, J. (2003), "Benchmarking performance indices: pitfalls and solutions", *Benchmarking: An International Journal*, Vol. 10 No. 1, pp. 9-28.
21. Pellegrino, G., D'Amato, S. & Weisberg, A. (2011), "The gender dividend: Making the business case for investing in women", UK: Delloite Touche Tohmatsu Limited, Available at: http://www.deloitte.com/assets/DcomGreece/dttl_ps_genderdividend_13 0111.pdf [Accessed 25 March 2013].

22. Punniyamoorthi, M. & Murali, M.R. (2006), "Balanced score for the balanced scorecard: A benchmarking tool", *Benchmarking: An International Journal*, Vol. 15 No. 4, pp. 420-443.
23. Schultz, H., Bagraim, J., Potgieter, T., Viedge, C. & Werner, A. (2003), *Organisational behaviour: A contemporary South African perspective*, Pretoria: Van Schaik Publishers.
24. Sekaran, U. (2003), *Research Methods for Business: A Skill Building Approach*, Fourth Edition, United States of America: John Wiley & Sons, Inc.
25. Shaikh, N.I. & Prabhu, V. V. (2009), "Monitoring and priorising alerts for exception analytics", *International Journal of Production Research*, Vol. 47 No. 10, pp. 2785-2804.
26. Suarez, J.G. (1992), "Three experts on quality Management: Philip B. Crosby, W. Edwards Deming, Joseph M. Juran", *Total Quality Leadership Office Publication*, Vol. 92 No. 2, Arlington, VA: Department of the Navy Total Quality Leadership Office.
27. Vinzant, J.C. & Vinzant, D.H. (1996), "Strategic management and total quality management: Challenges and choices", *Public Administrative Quarterly,* Vol. 20 No. 2, pp. 201-217.
28. Yang, C., Chang, C-J., Niu, H-J & Wu, H.C. (2008), "Increasing detectability in semiconductor foundry by multivariate statistical process control", *Total Quality management*, Vol. 19 No. 5, pp. 429-440.

BIOGRAPHICAL

Prof Sanjana Brijball Parumasur is in Industrial Psychologist and Professor at the University of KwaZulu-Natal, South Africa. Her publications have predominantly been in the areas of consumer behaviour, change management, organizational behaviour, organizational development and various aspects of human resource management. She has supervised an extensive array of masters and doctoral students in the fields of human resource management/development and industrial psychology. She serves on the Editorial Board of the International Retail and Marketing Review and the South African Journal of Industrial Psychology and reviews manuscripts for numerous local and international journals. She has presented several papers at local/international conferences.

Dr Patsy Govender is an academic in the School of Management at the University of KwaZulu-Natal, South Africa. She completed her doctoral degree in Human Resource Management at the University of KwaZulu-Natal. She currently lectures in management of human resource development, organizational behavior, employee wellness and HR planning and strategy. Her publications have predominantly been in the areas of total quality management, change management and managerial/leadership effectiveness and she has reviewed a text in HRM. She is actively involved in honours and masters supervision. She has presented several papers at local and international conferences.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

CONSUMER'S PERCEPTION OF RETAIL FORMATS – CASE OF POLAND

Radosław Mącik, Maria Curie-Skłodowska University, Faculty of Economics, Lublin, Poland, Pl. M.C. Skłodowskiej 5, 20-031 Lublin, Poland
E-mail: radoslaw.macik@umcs.lublin.pl

Dorota Mącik, University of Finance and Management in Warsaw, Faculty of Psychology, Warsaw, Poland, ul. Pawia 55, 01-030 Warszawa
E-mail: dorota_macik@tlen.pl

Monika Nalewajek, Maria Curie-Skłodowska University, Faculty of Economics, Lublin, Poland, Pl. M.C. Skłodowskiej 5, 20-031 Lublin, Poland
E-mail: mnalewajek@wp.pl

ABSTRACT

***Purpose**: Purpose of this paper is to compare perceived characteristics of different physical and virtual retail formats by consumers in Poland. There is proposed that physical and virtual retail channel are not only substituting themselves but also there is complementary each other. Analysis of changes over time is also important goal of the authors.*
***Design/methodology/approach:** Paper uses mainly quantitative approach. Main data source is CAWI questionnaire administered nationwide in 2012. Supplementary data are coming from study made in 2009. Representative to the population of Internet users in Poland samples of 1100 persons in both cases were obtained. There are also results from focus groups (FGIs) performed in 2012 and 2009 presented. Quantitative (from multidimensional scaling - MDS) and projective (from FGIs) perception maps are presented.*
***Findings:** For both time points MDS perception maps revealed similarity and differences patterns. Two dimensional solutions are fitting the data very well and allow to describe compared formats in following dimensions: 1) perceived level of personal interactions with the salesperson in particular retail format, and 2) perceived total cost for consumer. Virtual channel formats are forming distinct group – signalizing feeling of depersonalization of contact with customer. Standard forms of internet sales (online stores and auctions) are similarly perceived – as still having high perceived cost to the customer, despite lower perceived price level – this suggest that delivery time, necessity to return or sent to repair, are perceived as important drawbacks of such purchasing. Over the time visible is substantial change in discount stores perception – they become accessible for consumers even from small towns, and because of frequent location within/close to residential areas, they are substituting traditional local stores.*
***Originality/value:** Paper presents wide range of comparisons – up to 15 retail formats compared over two time periods. Authors are establishing method for further studies.*

Keywords: consumer behaviour, perception of retail formats, perception maps, Poland

INTRODUCTION

Preferences for retail channel and format choice within particular channel depend on factors external to the consumer and internal ones. Those preferences are subject to adaptive change when important factors occur.

External factors on macro level are influencing consumer preferences on general level, sometimes with prolonged lag. For instance cycles in economy, including crises or slowdowns are resulting in changes in consumers income, to which consumers should adapt changing spendings and structure of consumption. Another important factors are trends in retail industry, e.g. development of new sales channels and/or store formats, when they become visible to consumers. Since about last 20 years influence of technological change, mostly through information and communication technologies (ICTs), substantially increased. ICT is treated nowadays as general purpose technology (GPT) and its impact on economy (for both supply and demand sides is overwhelming (Basu and Fernald, 2007). For consumers this means to adopt ICT related devices and tools and get skills to operate them, to buy over the Internet or cope with self-service cash registers. For retailers it will need to follow technology change to be in touch with consumer needs and competitors – this can lead for instance to utilize virtual sales channel and become multi-channel retailer.

External factors on micro-level include among others: perceived price level (for the format, and particular retail outlet), physical effort to buy (including commuting), amount of time needed to fulfill shopping task (Peter and Olson, 2002). Most of micro-level external factor are creating perceived total cost of buying for the consumer, considered currently by growing numbers of consumers during their decision processes.

Among internal factors there are i.e.: consumer demographics, and consumer personality manifesting in decision-making styles and perceived level of cognitive and emotional effort connected with shopping. Although consumer personality issues are not considered in this paper directly, they are connected with emotions, lead to beliefs and attitudes. Such factors create emotional and rational perception of retail channels and formats mostly in terms of emotional attitude toward them, as well as in terms of perceived risk and trust for retail channel, format or particular outlet.

PREFERENCES FOR RETAIL CHANNEL AND FORMAT CHOICE

Studying store choice factors and issues has a long tradition from at least 70's of the 20th century. In earlier studies (Monroe and Guiltinan, 1975; Arnold *et al.*, 1978; Arnold *et al.*, 1983; Mason *et al.*, 1983; Keng and Ehrenberg, 1984; Louviere and Gaeth, 1987; Spiggle and Sewall, 1987; Dawson *et al.*, 1990; Burke *et al.*, 1992; Arnold *et al.*, 1996) – store choice task has been rationalized using different approaches regarding external and internal factors to the consumer. For instance the store attributes and situational factors were studied, shoppers and their households demographics, shopping patterns, attitudes toward stores, implied importance weights of factors like price level, store attractiveness or commuting distance etc. In more recent research studies were examined also other things i.e. the impact of task definition on store choice (Kenhove *et al.*, 1999), but most of mentioned store choice studies have been restricted to the same format, i.e., supermarkets or discount stores. There also exist some studies examining the influence of retail pricing formats on shopping behavior (Bell *et*

al.,1998), often assuming that one store format has in general higher prices than the other one. Bhatnagar and Ratchford (2004) represent interesting approach (limited to non-durable goods) to explore fixed and variable costs of shopping. Under assumption about consumers preferring to shop at minimum total cost, and different price levels between formats, they found conditions in which the store format choice would be optimal.

Although non-store retail has long tradition in some countries, with mail order popular in the past in Great Britain, Australia or Germany, this sales channel has been used by consumers mostly as addition to typical retail, not replacing directly (when possible) visits at stores. But situation changed since e-commerce began play important role in retail industry. Consumers are choosing not only store format but also channel of buying. Recent studies about channel choice and change (Gensler et al., 2012; Joo and Park, 2008; Mokhtarian and Tang, 2011; Schoenbachler and Gordon, 2002) are focused on the influence of consumer characteristics or perceived channel characteristics on channel choice at different stages of consumer decision-making process, mainly at information search and transaction (Mącik, 2012).

This paper focuses on perception of retail formats from both physical and virtual channel, on the base of declarations about shopping frequency and emotional attitudes toward them – from both quantitative and qualitative point of view. This approach with direct comparison of retail formats seems to be interesting and valid under circumstances of multichannel shopping behavior being nearly a norm or very common practice. So we do not assume, that channel is chosen first, and choice of store format is the next step in buying process. Qualitative investigation proved that channel choice is often situation driven, especially when there are no strong preferences to use particular channel. Also when seeking information is treated separately from actual buying, channel changes in both ways are occurring very often.

METHOD

Data presented in this paper are coming from two large nationwide samples, about 1100 subjects each. Data were collected by CAWI questionnaire in 2009 for first sample and at the end of 2012 for the second one. Quantitative data are representative for population of Internet users in Poland regarding gender and age (between 18 and about 65 years old). Additional data used are coming from focus groups (FGIs) – performed in January 2013 to deepen knowledge gathered from second quantitative study. FGI participants (n=30) were differing in age (between 20 and 67yo) and gender. Some background data from previous studies and statistics of retail sector in Poland were also provided.

Used measures include among others declared frequency of using particular formats within both channels (15 formats for 2012 and 12 formats for 2009) as well as emotional attitudes toward them.

Data analysis relies on descriptive statistics and graphs. Multidimensional scaling procedures (MDS) to produce perception maps were used. Also projective perception maps provided by FGIs participants were aggregated and discussed. There should be noted that presented analysis has an exploratory character. No exact hypotheses have been settled and tested in this case.

Research has been founded from public funds through grant given by Polish National Center for Science to first author.

RETAIL SECTOR IN POLAND

Economic transition in Poland starting at 1989 involved substantial changes in Polish retail sector. It is worth to note, that even before 1989 in Poland existed in noticeable numbers private-owned shops, but economic system changes led in early 90's of 20th century to very quick growth of the number of retail outlets, mostly independent and family owned. Foreign capital store chains entered the market right after introducing hypermarket and supermarket formats into larger Polish cities first. About 2000 there was also discount store format introduced. Since 2005 there is visible concentration of sales volumes in mentioned store formats, and after 2009 systematic decrease of number of independent, small stores. Some statistics about retail outlet numbers are shown on Figure 1.

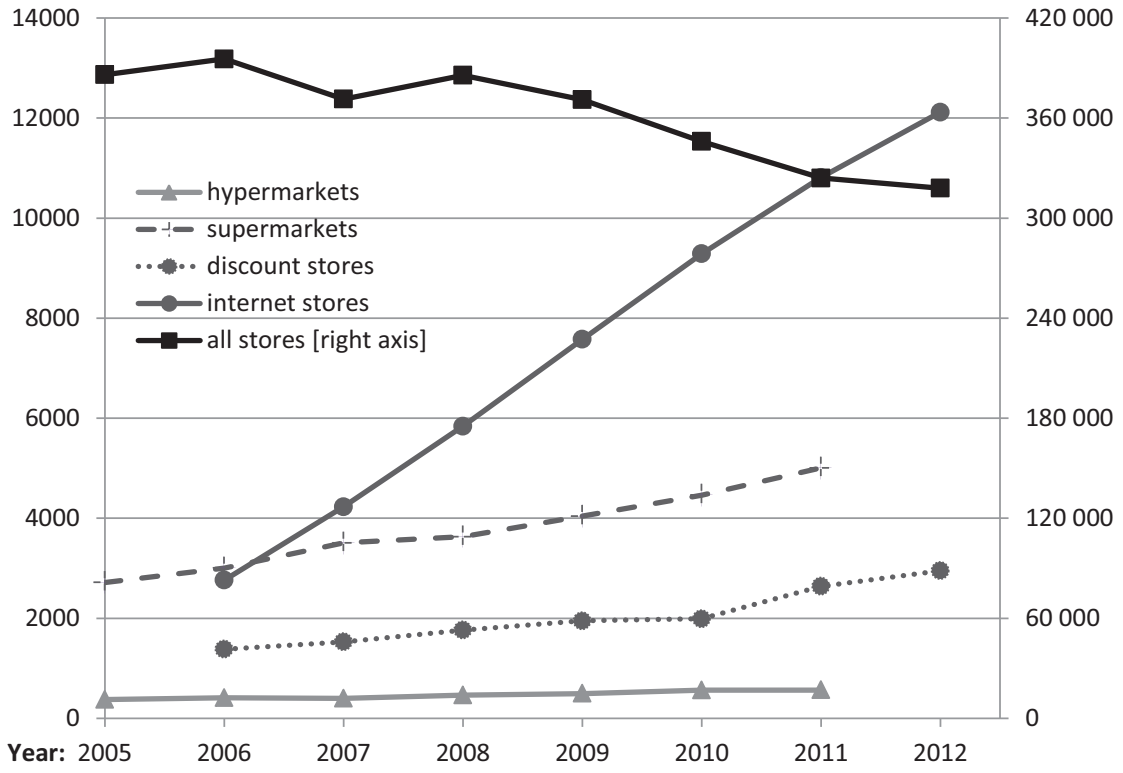


Figure 1. Changes in numbers of selected formats of retail outlets in Poland (2005-2012)

Note: All stores number is depicted on right axis, numbers for particular formats – on left one.
Source: Polish Central Statistical Office (GUS), GfK Polonia, Nielsen, Sklepy24.pl

During the time hypermarket format lost their leadership in driving changes of retail sector in Poland – its share in total sales according to Nielsen data decreased from 15 to about 13% (between 2006 and 2011), when number of hypermarkets increased by ca. 38%. Limited number of larger cities in Poland and aversion to drive longer for shopping leaded to growth of supermarket format first and discount format later. Such stores were located with time with

smaller towns, and were successfully competing on local markets with more traditional FMCG stores, despite entering to store-chains and remodeling into convenience format. Between 2006 and 2011 share in total retail sales through supermarkets increased by about 2 percentage points to 17%. For discounts growth was more dynamic – 7 percentage points (to 20% share in 2011). Main discount chains in Poland (Biedronka, Lidl and Netto) are employed rather soft discounter strategies after 2010, and are growing in terms of store numbers very quickly. Biedronka ("ladybug" in Polish) is unquestioned market leader for this format with about 2000 local stores under this brand.

Virtual channel in Poland is dominated since many years by one auction platform – Allegro.pl. Despite this, number of active internet shops increases rather quickly with growth of e-commerce sector (between 2006 and 2011 number of internet stores increased from 2800 to about 12100, and its share in total retail grown from about 1% to circa 3-4% according to various sources (Chodak et al., 2012). Most of internet shops are small firms – about a half of them employs no more than two persons. As mentioned auction platform Allegro.pl generates about half of total Polish B2C e-commerce turnover, about of 20% of internet stores in Poland is generated through this platform. Also about half of internet stores are multi-channel sellers, having at least one physical store (Chodak et al., 2012).

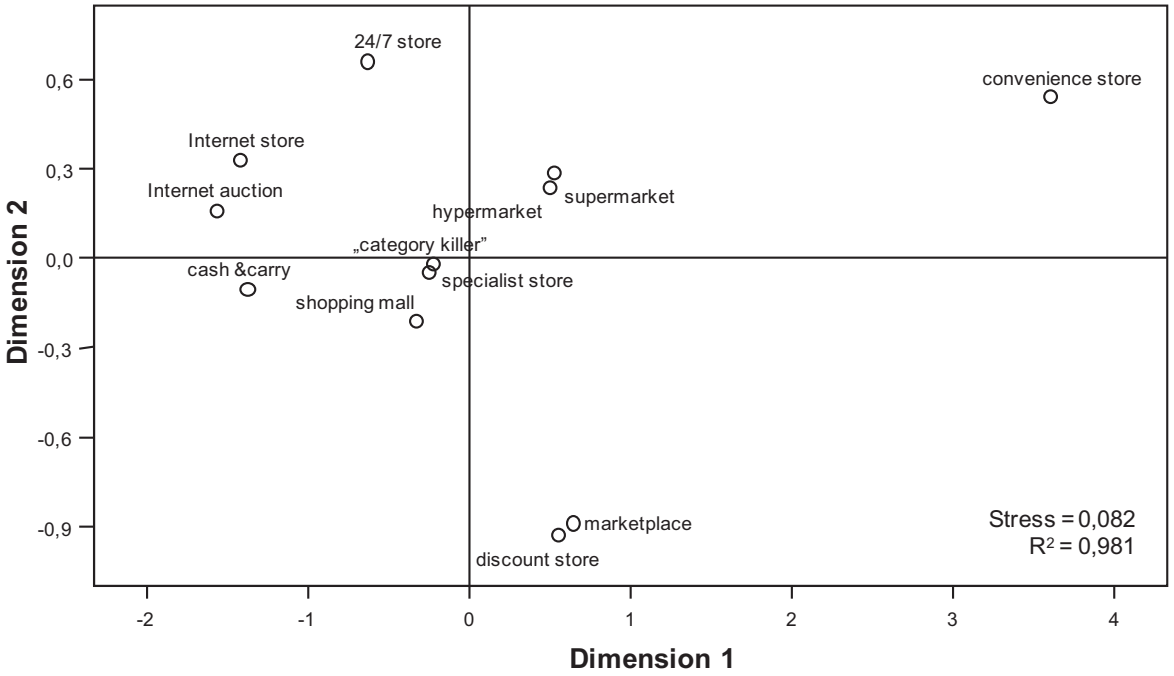
PERCEPTION OF STORE FORMATS BY POLISH CONSUMERS – QUANTITATIVE APPROACH

For visual interpretation of perceived attributes of analyzed retail formats, ALSCAL procedure – one from typical algorithms for multidimensional scaling – has been performed. Figure 2 contains graphical representation of two main dimensions revealed from 2009 and 2012 samples respectively.

Dimension 1 – horizontal one on Figure 2 – can be interpreted as perceived level of personal interactions with the salespersons in particular retail format – (with alternative explanation of representing consumer familiarity with particular format). While dimension 2 – vertical one on Figure 2– represents perceived total cost for consumer in sense described by Peter & Olson (2002, p. 459-461).

Provided interpretation is more clear for 2009 data, and for new data set should be used more carefully, although there are no direct suggestions indicating that such approach is not appropriate.

a) **2009 data**



b) **2012 data**

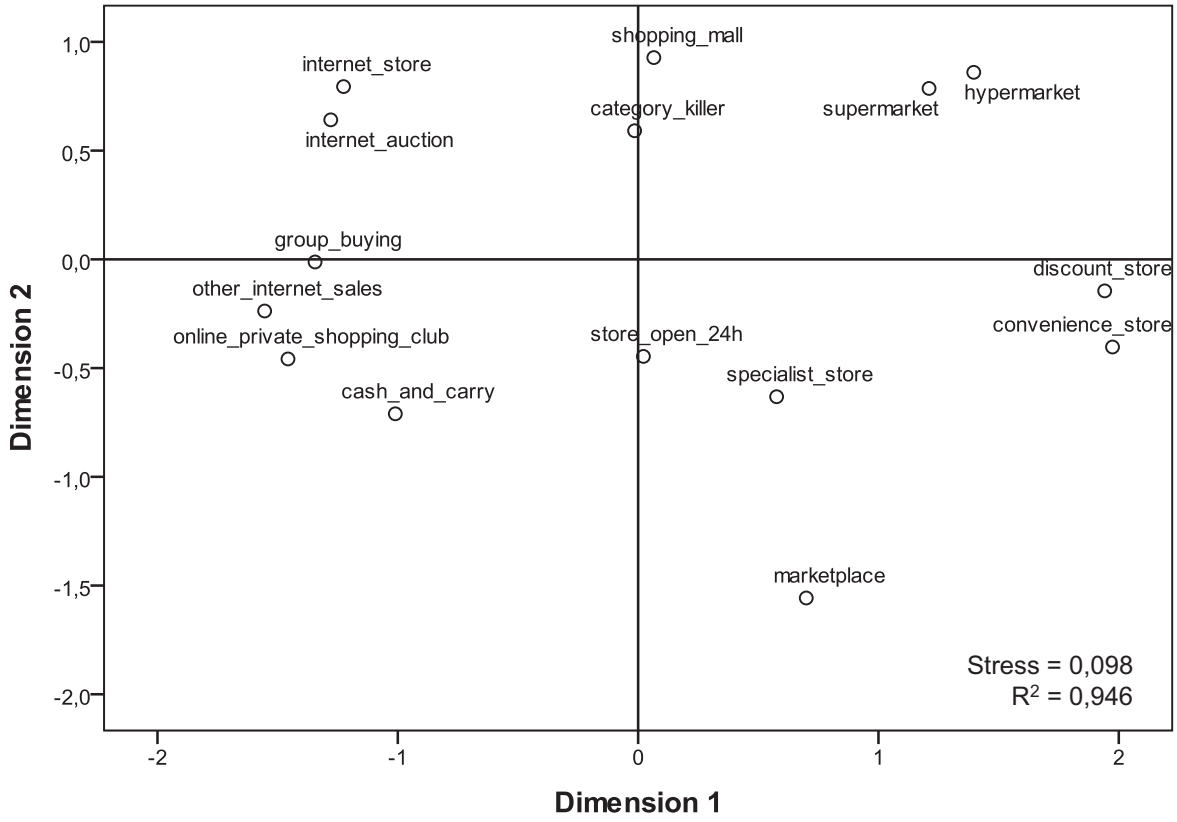


Figure 2. Perception maps of retail formats on the base of declared shopping frequency – multidimensional scaling approach (ALSCAL procedure, Euclidean distances)
Source: own research

Two-dimensional solution for both cases fits the data very well. Also Stress value is better or close than acceptable 0,1, and R^2 statistic is very high, exceeding minimum of 0,6 (Borg & Gronen 2005, p. 48).

In both cases virtual channel formats are forming group on the left side of dimension 1 – signalizing feeling of depersonalization of contact with customer. Also standard forms of internet shopping (online stores and online auctions) are similarly perceived – still having high perceived total cost to the customer, despite lower than in physical retail perceived price level – this suggest that time of delivery, possible need to return (i.e. clothing) or sent to repair (i.e. consumer electronics), are seen as important drawbacks of such purchasing. For other formats of internet sales included in 2012 study, perception of substantially lower price creates climate of "good deal" (in qualitative study this has been explained by younger participants in the context of group purchasing via Groupon or similar places as "real" price to the value, "affordable" price – in most cases persons using such offers declared not buying things or services different way (good example is expensive SPA package bought via Groupon by young student – catalogue price was in this case far beyond payment possibilities of this person). Group purchasing and private online shopping clubs by creating limited time offers are successfully exploiting hedonic motives of consumption and tendency for impulsive buying – this was not seen by consumers.

Comparing map from 2009 research with new one, very visible is dramatic change in discount stores perception among consumers – during the time between both measurements they become accessible by most consumers even in small towns, and because of location policy, within or close to residential areas, they are substituting larger independent convenience stores. It is worth to note that stores described as discounts became between two measurements rather soft discounters – two main chains in Poland – mentioned "Biedronka" and "Lidl" – are not focused only on low prices (but still communicating them in ads), instead they introduced many premium products (mostly under own labels) to their assortment, and consumers are perceiving them as at least not worse quality comparing main national brands.

The second important change is differentiation between classical specialist stores and so called "category killers" – mass merchandisers with deep product assortment within specialized product categories (like consumer electronics, home and garden ect.). In qualitative study (using FGIs) this difference has been explained as follows: classical specialist stores are perceived as trustworthy, so consumers often are using them to get more specific information about products, than to buy – they want to buy in such stores (have positive attitudes toward them), but at the same time higher prices are driving them out of this format. In "category killer" stores consumers are instead more prone to perform so called "showrooming" – looking at/experiencing product in-store with clear intention to buy it cheaper online.

Perception of stores open 24/7 also changed significantly during last years – previously they were referred mostly as small shops existing in little numbers selling mainly alcoholic beverages (with prices surcharged for "availability", and not easily accessible in terms of time to get in). Now they are perceived in most cases more similarly to smaller convenience stores with very limited assortment of FMCG merchandise – mostly snacks and beverages – as well as simple bistro-type gastronomy. This format nowadays is connected with gas

stations facilities, and total cost to the customer is perceived as lower than previously, as they are easier available.

Most isolated format in 2009 study was convenience store – differing significantly from other formats in both dimensions, in 2012 research isolated is marketplace – perceived as a sales format with lowest cost to the consumer. Similarities in perception between hypermarkets and supermarkets still persists, and today more often than previously the same store brands are operating simultaneously in both formats – good example of such strategy is Tesco, having older hypermarkets in large cities, and supermarkets in smaller towns. Also shopping malls and "category killers" are still similarly perceived

EMOTIONAL ATTITUDE TOWARD RETAIL FORMAT AND SHOPING FREQUENCY

Declared shopping frequency should be connected with emotional attitude toward particular store format. Mentioned variables are plotted Figure 3 confirming this relationship – they are highly correlated – Pearson correlation coefficient r equals +0,845 (p=0,000), suggesting very strong positive correlation. This is reasonable because consumers are buying more frequently at places they like – on the level of format as a whole and particular store location. Buying at places not preferred emotionally involves perception of taking greater risk – which should be rewarded by substantially lower price or other bonus having value for the consumer.

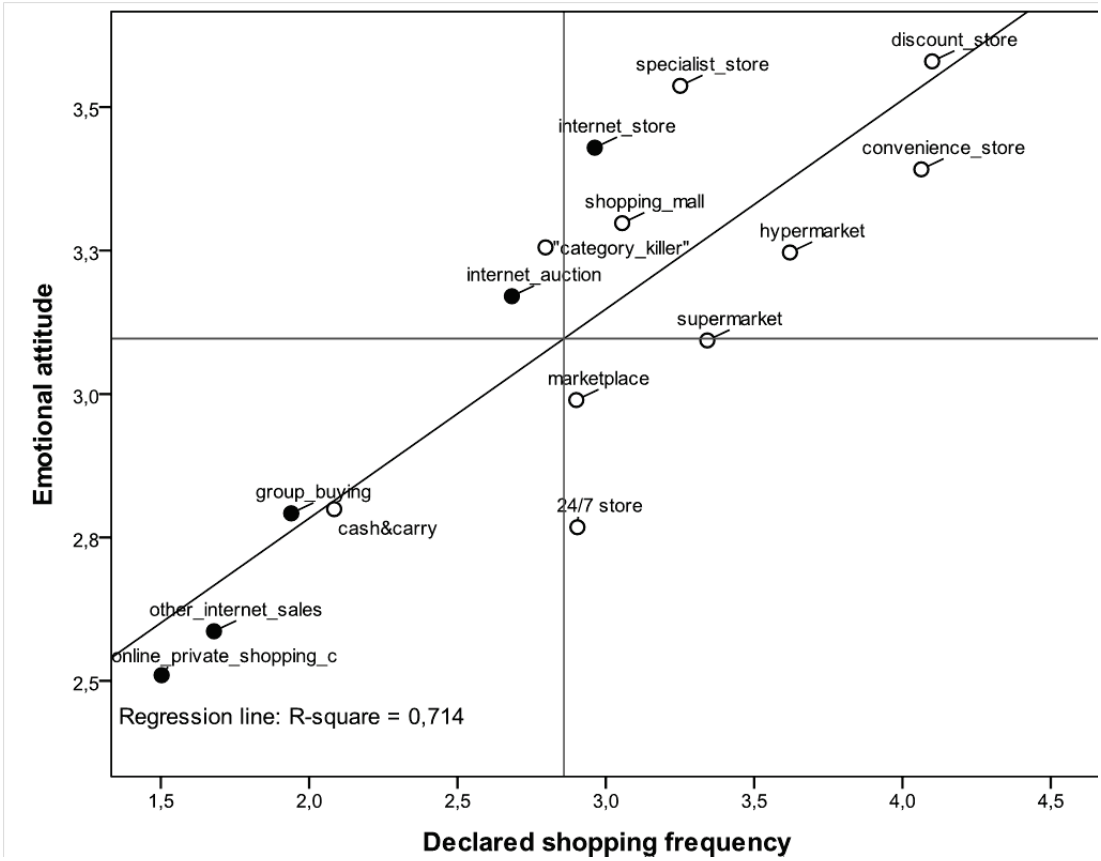


Figure 3. Declared shopping frequency vs. emotional attitude toward retail format (2012) Source: own research

Regression line plotted on figure 3 allows easily find formats for which declared shopping frequency differs much from emotional attitude. Highest positive difference is for internet stores and specialist stores (both perceived better emotionally than used frequently), and greatest negative distance (suggesting disliking) is for 24/7 stores.

Most positive attitudes are connected with discount stores – people feel "smart" buying at discounts – it saves money and time, gives access to interesting products perceived as having good value. Most negative attitudes (disliking) are for two relatively new internet sales formats: online private shopping clubs and informal internet sales (mostly C2C – not using auction platforms but rather social media tools). This comes from little knowledge about those forms – from cognitive perspective it is hard to like the unknown. More often used group buying is connected with more positive attitudes.

Positive attitude toward internet stores leads to conclusion that consumers want to buy more often in them, than do this in reality. Positive attitude comes in this case from availability of products not easily accessible in physical retail, and from ease to perform comparison shopping – as expressed by focus group participants, while main force prohibiting the consumers to buy at internet stores is still a risk, perceived mainly as possible delay with shipping and logistics, hidden costs or future problems after purchase. Consumers also like specialist stores – they trust the salespersons, appreciate their professional knowledge and advice, but think that price level is too high for them to made transaction. As common market practice in Polish specialist stores is having many products available on order, which consumers dislike (they must wait instead getting products immediately – and immediate availability is perceived as one from main advantages of physical retail), in effect many purchases are done outside this format, mainly over the Internet or through large store chains.

Not liking, but quite often buying in 24/7 stores is obviously connected by respondents with shopping by the way of fuel purchasing – this is sometimes perceived as overspending or with necessity to buy some FMCG products (including alcoholic beverages) beyond typical open hours. It is worth to note that in Poland there are very little restrictions of open days/hours for retail (most of shops must be closed on 12 National or Christian holidays in year only), but limited demand causes that only in large cities exist larger stores open 24/7 (for instance in Lublin having about 350 thousand inhabitants only one Tesco hypermarket is open 24/7).

PERCEPTION OF STORE FORMATS BY POLISH CONSUMERS – QUALITATIVE APPROACH

Because CAWI questionnaire to be effective must be as short as possible, authors incorporated topic of store formats perception to qualitative parts of both research. There was in both cases technique called projective perception map utilized, where FGI participants using response cards with empty perception map should as quickly as possible locate positions of objects from given list on two-dimensional space according to personal perception. One map with dimensions labeled: "unsafe" vs. "safe" (horizontal one), and "inexpensive" vs. "expensive" (vertical one) has been used in 2009 study. In recent research two such maps were provided to participants: first exactly the same as in 2009, and second labeled: "inconvenient" vs. "convenient" (horizontal dimension), and "I dislike" vs. "I like" (vertical one). The task was to locate positions of 5 main formats in 2009 (3 physical and 2

virtual), changed to locate up to 15 formats in early 2013 (10 physical and 5 virtual). Example of filled response cards from early 2013 are shown on Figure 4. Time between main CAWI study at the end of 2012 and FGIs from early 2013 not exceeded two months.

Individual responses were aggregated by coding positions for each format on the map. Next step was to find centroid of individual responses (with extreme outliers eliminated from analysis). Figure 5 contains aggregated map from 2009 – at this time formats asked were perceived consistently regardless of age and gender – so only one map is provided. Findings from early 2013 are shown on 8 separate perception maps (two maps for each from four age groups) – Figure 6.

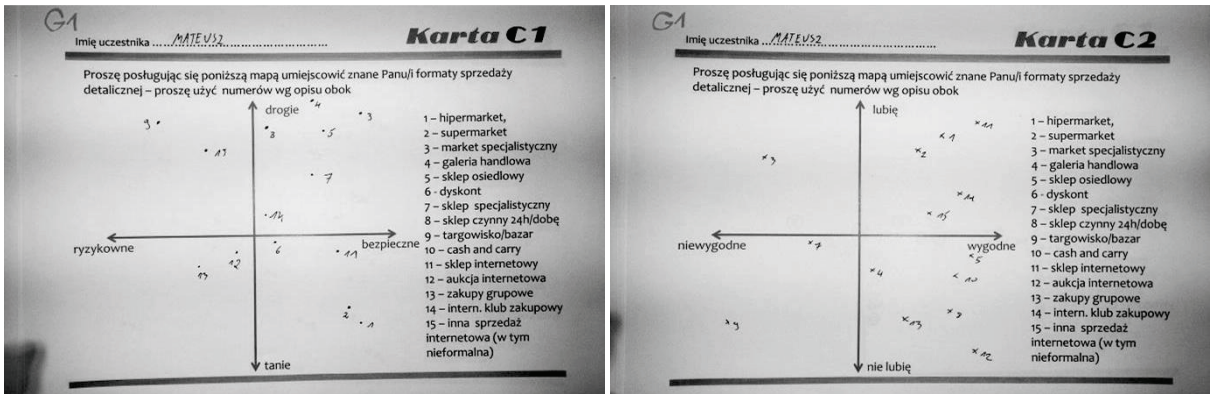


Figure 4. Examples of individual perception map from early 2013 study
Source: own research

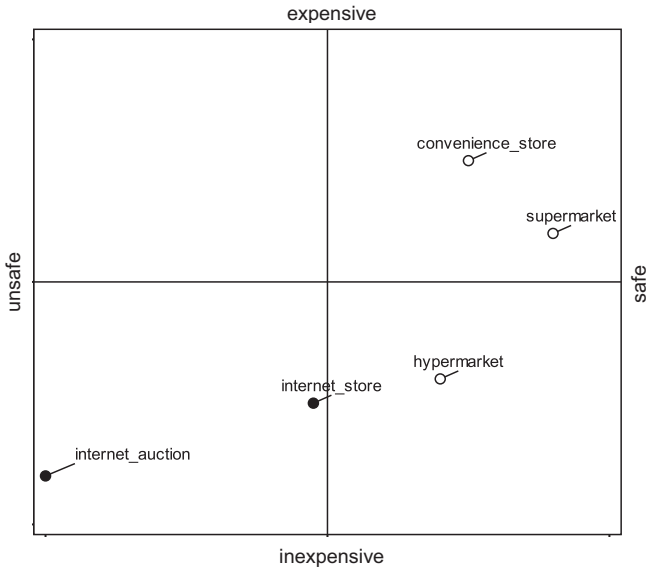


Figure 5. Projective perception map of retail formats – aggregation of all groups (2009)
Source: own research

Simple conclusion from 2009 map is that virtual channel formats were perceived less expensive than main formats from physical channel, and less safe (particularly Internet auctions). Lover price was expected compensation for lower safety of purchasing. Other costs than listed price were probably neglected by consumers participating in this research.

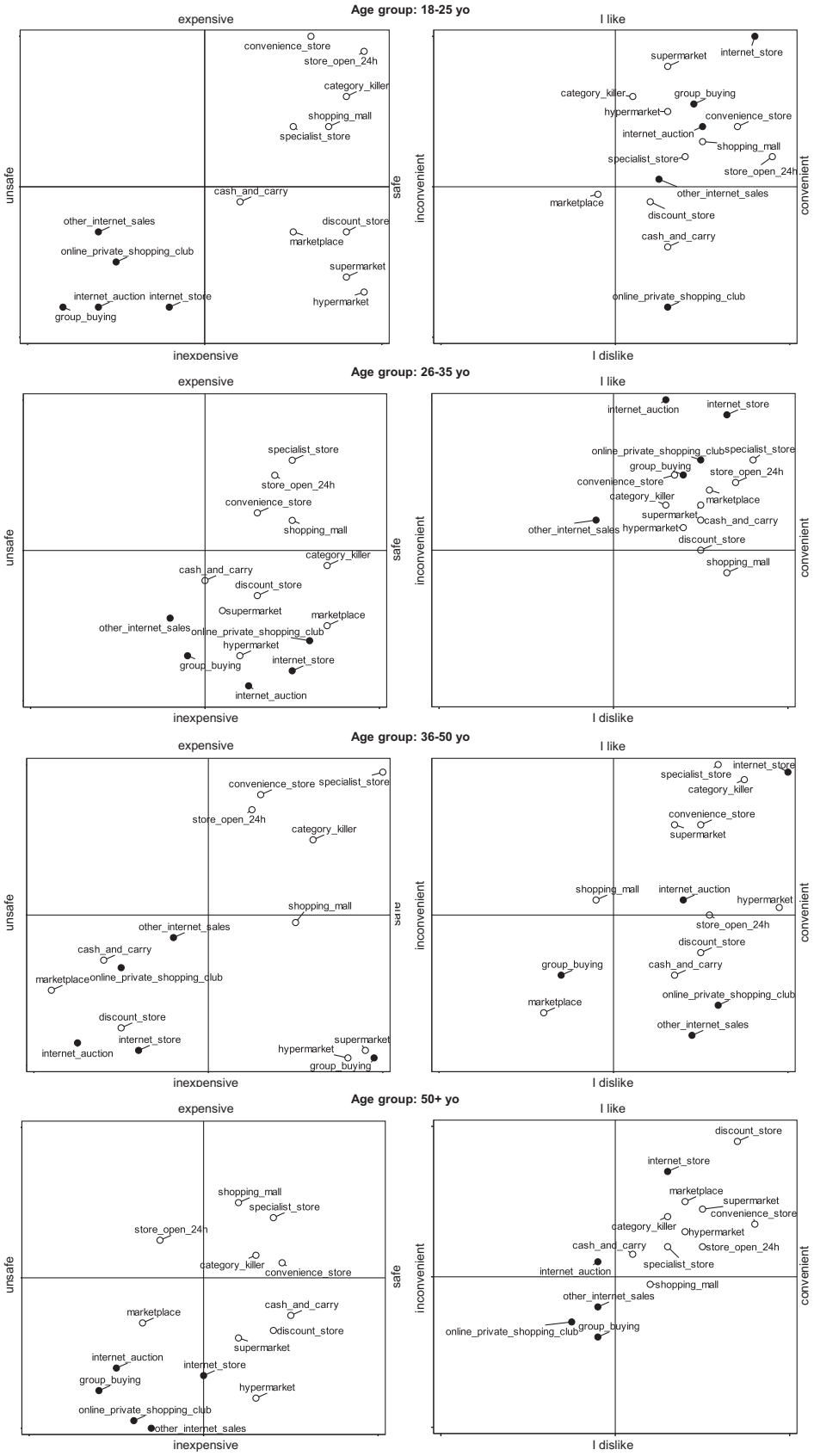


Figure 6. Projective perception maps of store formats by age groups (2012)
Source: own research.

As results from 2009 were very general, for next study more detailed approach has been used. Results shown on Figure 6 for separate age groups and two set of descriptors for each group allow to compare influence of age on perception of store formats, particularly those utilizing the Internet, which was harder to find on quantitative level (although UNIANOVA results – not presented in this paper – are consistent with qualitative findings).

Virtual retail formats are perceived as different than most formats of physical retail in terms of perceived price level an safety of purchase – they are perceived as having low listed price level and less safe comparing to physical stores. For youngest group three clusters are visible – mentioned virtual retail formats together are forming first group (inexpensive and unsafe), second group is perceives as inexpensive and safe (mostly grouping so called modern physical formats), and the third group consists of more traditional formats with shopping malls and category killers as replacements of their traditional counterparts. Interesting is similar pattern obtained in youngest focus group and group with persons aged 36-50 – in both groups perception of Internet retail is very similar (cheap and risky), this similarity applies also to perception of some physical formats perceived as safe and expensive (this applies for instance to convenience stores and 24/7 stores). Some similarities exist for mentioned dimensions between groups 26-35yo and 50+ yo (for example specialist stores).

For second set of descriptors interesting is perceiving nearly all store formats as convenient (only for 50+ group virtual retail – excluding internet stores – is rather inconvenient). Both younger groups are liking most of modern retail formats including virtual ones (with exception for discount stores). For both older groups disliking internet retail is more common, although for 36-50yo group disliking them not implies perceiving them as inconvenient. It should be noted that in this age group there was much more disliked formats comparing to other groups.

Discount stores and also cash and carry format were most disliked formats. Internet stores are liked very much and at the same time perceived as very convenient retail format. This not applies to very popular in Poland auction platforms – they are perceived as less convenient and less liked in comparison to internet stores.

Also there is a need to point out less positive perception of discounts in qualitative data – they are perceived as less convenient than other formats and rather disliked, but less expensive, [and what was not measured directly they are close to the consumers].

CONCLUSION

There are quite substantial differences in perception of retail formats. Still virtual retail is perceived as less safe, but also less expensive. For common types of internet sales even older persons have rather positive attitudes (younger ones have such attitudes for all virtual formats). Internet retail is perceived also as convenient.

Comparing results from quantitative part with qualitative ones visible is discrepancy in perception of gaining popularity discount stores – perceived similarly to convenience stores when investigated quantitative way, they show less positive perception in qualitative data – are perceived as less convenient than other formats and rather disliked, but less expensive.

All presented research conducted by authors allowed to build set of research tools and analysis techniques (both quantitative and qualitative) useful to assess perception of different retail formats. Results from different approaches are convergent each other and graphical way of their presentation is easy and useful. Repeating measurements over time allow also to examine changes in perception (when treated as longitudinal data from consumer panel). Lack of strong cultural cues in questions and response cards allows with ease international comparisons.

REFERENCES

1. Arnold, S. J., Handelman, J., & Tigert, D. J. (1996). *Organizational legitimacy and retail store patronage*. Journal of Business Research, 35(3), 229– 239.
2. Arnold, S. J., Ma, S., & Tigert, D. J. (1978). *A comparative analysis of determinant attributes in retail store selection*. In H. K. Hunt (Ed.), *Advances in Consumer Research*, vol. 5 (pp. 663–667). Ann Arbor, MI: Association for Consumer Research.
3. Arnold, S. J., Oum, T. H., & Tigert, D. J. (1983). *Determinant attributes in retail patronage: Seasonal temporal, regional and international comparisons*. Journal of Marketing Research, 20(2), 149–157.
4. Basu, S. and Fernald, J. (2007), "Information and communications technology as a general-purpose technology: Evidence from US industry data", *German Economic Review*, Vol. 8 No. 2, pp. 146–173.
5. Bell, D. R., Ho, T., & Tang, C. S. (1998). *Determining where to shop: Fixed and variable costs of shopping*. Journal of Marketing Research, 35(3), 352– 369.
6. Bhatnagar, A., Ratchford, B. T. (2004), *A model of retail format competition for non-durable goods*. International Journal of Research in Marketing, 21(1), 39-59.
7. Borg I., Groenen P.J.F. (2005), *Modern Multidimensional Scaling: Theory and Applications*, 2nd Ed., Springer.
8. Burke, R., Bari, R., Harlam, A., Kahn, B. E., & Lodish, L. M. (1992). *Comparing dynamic consumer choice in real and computer- simulated environments*. Journal of Consumer Research, 19(1), 71–82.
9. Chodak, G., Jarosz, P., Kunkowski, J., Polasik, M., Tkaczyk, P. and Wrzalik, P. (2012), *Raport eHandel Polska 2012. Analiza wyników badania polskich sklepów internetowych*, DotCom River, Sklepy24.pl, Wrocław.
10. Dawson, S., Bloch, P. H., & Ridway, N. M. (1990). *Shopping motives, emotional states and retail outcomes*. Journal of Retailing, 66(4), 408–427.
11. Gensler, S., Verhoef, P.C. and Böhm, M. (2012), "Understanding consumers' multichannel choices across the different stages of the buying process", *Marketing Letters*, Vol. 23 No. 4, pp. 987–1003.
12. Joo, Y.-H. and Park, M.H.-J. (2008), "Information search and purchase channel choice across inhome shopping retail formats", *Academy of Marketing Studies Journal*, Vol. 12 No. 2, pp. 49–61.
13. Keng, K. A., & Ehrenberg, A. S. C. (1984). *Patterns of store choice*. Journal of Marketing Research, 21(4), 399–409.
14. Kenhove, P., Wulf, K., & Waterschoot, W. V. (1999). *The impact of task definition on store-attribute saliences and store choice*. Journal of Retailing, 75(1), 125–137.
15. Le Roux, B. and Rouanet H. (2004). *Geometric Data Analysis, From Correspondence Analysis to Structured Data Analysis*. Dordrecht: Kluwer

16. Louviere, J. J., & Gaeth, G. J. (1987). *Decomposing the determinants of retail facility choice using the method of hierarchical and international comparisons*. Journal of Marketing Research, 63(1), 149–157.
17. Mącik R., Mazurek G, and Mącik D. (2012). *Channel characteristics influence on physical vs. virtual channel choice for information search and purchase - the case of Polish young consumers,* International Journal of Cyber Society and Education, 5(1), 35–54.
18. Mason, J. B., Durand, R. M., and Taylor, J. L. (1983). *Retail patronage: A causal analysis of antecedent factors*. In W. Darden, & R. Lusch (Eds.), *Patronage behavior and retail management* (pp. 339–352). New York: North-Holland.
19. Mokhtarian P.L. and Tang W. L. (2009), *Accounting for Taste Heterogeneity in Purchase Channel Intention Modeling: An Example from Northern California for Book Purchases*, Journal of Choice Modelling, 2(2), 148-172, 2009.
20. Mokhtarian P.L. and Tang W. L. (2011), *Trivariate probit models of pre-purchase/purchase shopping channel choice: clothing purchases in northern California*, paper presented at International Choice Modelling Conference 2011, Oulton Hall (UK) 4–6 July 2011, http://www.icmconference.org.uk/index.php/icmc/ICMC2011/paper/view/426/119
21. Mokhtarian, P.L. and Tang, W.L. (2011), "Trivariate probit models of pre-purchase/purchase shopping channel choice: Clothing purchases in northern California". Retrieved from http://pubs.its.ucdavis.edu/download_pdf.php?id=1611
22. Monroe, K. B., & Guiltinan, J. P. (1975). *A path-analytic exploration of retail patronage influences*. Journal of Consumer Research, 2(1), 19– 28.
23. Peter J.P., Olson J.C. (2002), Consumer Behavior and Marketing Strategy, Homewood, IL: Irwin – McGrawHill,
24. Schoenbachler, D.D. and Gordon, G.L. (2002), "Multi-channel shopping: Understanding what drives channel choice", *Journal of Consumer Marketing*, Vol. 19 No. 1, pp. 42–53.
25. Spiggle, S., & Sewall, M. A. (1987). *A choice set model of retail selection*. Journal of Marketing, 51(2), 97–111.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

CUSTOMER-BASED PERFORMANCE ON CUSTOMER RELATIONSHIP MANAGEMENT : THE ROLE OF CUSTOMER RELATIONAL INFORMATION PROCESS

Hsinhsin Chang, National Cheng Kung University, Taiwan
Email: easyhhc@mail.ncku.edu.tw

Powen Fang, National Cheng Kung University, Taiwan
Email: r4896104@mail.ncku.edu.tw

Fangju Cho, National Cheng Kung University, Taiwan

ABSTRACT

Purpose: *Customer relationship management (CRM) is an important tool to achieve marketing strategy for firms. This study investigated the influence of completeness of CRM relational information processes on customer-based performance. Besides, interaction orientation and CRM system readiness were adopted as moderators on the relationship between CRM relational information processes and customer-based performance.*
Design/methodology/approach: *Both qualitative and quantitative approaches were applied in this study.*
Findings: *The results revealed that completeness of CRM relational information processes indirectly and positively affects customer-based profit performance through customer-based relational performance. The implication and suggestion for managers were also discussed.*
Originality/value: *This study showed that well-built information processes strengthen customer-based relational performance. Moreover, managers should thoroughly strengthen customer-based relational performance to promote the customer-based profit performance. Finally, managers should build appropriate CRM technology systems and create complete rules, rewards and mechanisms to meet the developmental level of the CRM relational information processes and further promote customer-based performance*

INTRODUCTION

In the past, Customer Relationship management (CRM) performance was mostly measured by the financial outcome. Estimating customer loyalty through customer behavior is one of the methods that has been used to measure customer value. In order to measure customer value precisely, CRM performance must be evaluated by different evaluation metrics. In other words, a firm that has adopted a customer-centric philosophy must have different evaluation criteria than product-centric organizations (Sheth ,Sisodia, & Sharma 2000). Therefore, this study adopts customer-based performance, which has rarely been used in the past to evaluate CRM performance. Further, in customer-based performance metrics, this study not only investigates customer-based relational performance, which focuses on the behavioral dimension, but also employs customer-based profit performance, which focuses on the attitude dimension to more comprehensively evaluate customer-based performance.

In addition, this study is intended to lead to an understanding of weather there are influencing factors on the relationship between CRM relational information processes and customer-based performance. Therefore, the trend of individual marketing, this study puts the concept of interaction orientation into a research model. Nowadays, customers require more specific offerings to meet their heterogeneous demands. Firms collect and analyze customer data at the individual level in order to recognize each customer's individual needs. For firms, the method of interaction orientation can facilitate the collection of data through communicating with each customer. Ramani and Kumar (2008) considered the idea that interaction orientation reflects a firm's ability to interact with its individual customers and to take advantage of information obtained from them through successive interactions to achieve profitable customer relationships. Thus, interaction orientation assists in the accomplishment of CRM relational information processes more smoothly and further, cooperatively promotes customer-based performance.

Moreover, the implementation of a CRM system induces huge changes in processes, technology, and the people in firms. Reinartz, Karfft, and Hoyer (2004) suggested that CRM-compatible organizational alignment and CRM technology positively moderate relationships between CRM processes and economic performance. CRM system is a technology-oriented business strategy. The key point is that CRM technology plays a critical role in the context of leveraging CRM-related activities and thus contributes to improved organizational performance in the market (Reinartz et al., 2004). CRM system readiness is a facilitator of information processes that leads to better firm performance. Although prior scholars have suggested many factors that may affect CRM implementation, there is little

research specifying these factors as constructs. Thus, this study combines these factors into a single construct labeled as CRM system readiness.

Based on the discussion above, this study presents a framework with which to explore how a CRM information system is manipulated and how the performance of a CRM informational system is affected in a service industry. The purpose of this study investigates (1) to evaluate whether well-built information processes have a positive influence on customer-based performance, and (2) to assess the moderating effect of interaction orientation and CRM system readiness on information processes leading toward customer-based performance.

THEORTICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

1. CRM Relational Information Processes

The definition of relevant information processes in this study is the process of segmenting customers and tailoring relevant offerings for them to create value for a firm (Day, 2003). This study defines CRM relational information processes as a procedure of data collecting. Firms can have contact with their customers and gather relevant data at the same time through various channels. The data then is stored in database that can be analyzed and transformed into useful information and concurrently supplied to front offices for the management of customer relationships.

2. Customer-based Performance

Chang and Wong (2010) mentioned that CRM enhances a company's competitive capabilities such as cost reduction and market share enlargement, within the environment of a web based value chain integrated by internal operations, suppliers and customer relationships. This study applies customer-centric performance measures: customer-based relational performance and customer-based profit performance (Ramani & Kumar, 2008). Customer-based relational performance assesses performance on attitudinal parameters, whereas customer-based profit performance assesses performance on behavioral parameters.

2.1 Customer-based Relational Performance

The measurement of customer-based relational performance stresses the evaluation of the relationship between firms and customers, which presents customer attitudes toward a given firm. Ramani and Kumar (2008) identified the measure of customer-based relational

performance in terms of three indicators: customer satisfaction, customer ownership, and positive word of mouth. Customer-based performance is a different way to measure information processes and also bring benefits to firms. This study focuses on customer relationships to develop the dimension of customer-based relational performance. The dimensions include customer satisfaction, customer ownership and positive word-of-mouth, which cultivate customer loyalty and sustain long term relationships.

The completion of CRM relational information processes includes information reciprocity, information capture, information integration, information access, and information use. The implementation of entire processes certainly requires collaboration among all of the various functions. This results in a complete realization of customer needs and an adequate utilization of customer information to design marketing activities. Customers can obtain what they want, and firms can gain profit from customer satisfaction; meanwhile customer satisfaction can bring positive word-of-mouth communication to firms. According to the above description, this study develops a hypothesis as follows:

H1: *CRM relational information processes positively affect customer-based relational performance.*

2.2 Customer-based Profit Performance

Customer-based profit performance includes three dimensions: identifying profitable customers, acquiring and retaining profitable customers, and conversing unprofitable customers to profitable ones. These three dimensions are applied to measure customer value, and based on this; firms can assign resources and develop marketing strategies.

Firms that invest in information processes that enhance their interaction response capacity and implement their customer value management practices are in a position to distinguish between the characteristics of profitable customers and those of unprofitable customers and can use this information to identify potentially profitable customers (e.g., Reinartz & Kumar, 2003). Firms that have well-built information processes and provide customized and personalized offerings can evoke customer intention to maintain long-term relationships. According to the above description, this study develops a hypothesis as follows:

H2: *CRM relational information processes positively affect customer-based profit performance.*

2.3 Customer-based Relational Performance to Customer-based Profit Performance

Customer-based relational performance assesses performance on attitudinal variables, whereas customer-based profit performance measures performance on behavioral variables. In accordance with the theory of planned behavior, Ajzen (1991) determined that customer attitude (e.g., satisfaction, ownership, and word of mouth) influences firm behavior (e.g., identifying profitable customers, acquiring and retaining profitable customers, and converting unprofitable customers to profitable ones). A higher level of customer-based relational performance has direct effects on customer-based profit performance. As long as customers are satisfied with firm offerings, they exhibit repurchase behavior (Spiller, Vlasic, & Yetton, 2007). Additionally, firms can understand customer requirements through information processes designed to analyze customer purchase history and preferences, thus helping sales managers to identify and target their most valuable customers. According to the above description, this study develops a hypothesis as follows:

H3: *Customer-based relational performance positively affects customer-based profit performance.*

3. Interaction Orientation

Firm-customer interaction is two-way; firms not only obtain customer data, but customers also receive up to date information about firms. This two-way interaction allows firms and customers to understand each other completely. Moreover, firms analyze customer data at the individual level, which can allow firms to provide customized products/services to fulfill customer demands.The market success of service organizations is crucially dependent on the interaction between frontline employees and customers (Ramani & Kumar, 2008; Chang & Ku, 2009).

Jaramillo and Grisaffe (2009) noted that customer orientation should have positive effects on performance. Customer-oriented selling should also increase customer satisfaction, which leads to overall better performance when satisfied customers reward salespersons by continuing to place repeat orders (Poddar, Donthu, & Wei, 2008). Salespersons with high levels of interaction orientation truly are concerned about customers and thus engage in actions related to customer value such as listening to customer feedback and solving customer problems. Together, interaction orientation and adaptive selling lead to win-win outcomes because customers are served in better and more individually relevant ways,

producing higher levels of success for the sales force and the organization (Jaramillo & Grisaffe, 2009). By CRM relational information processes, firms are able to gather and utilize complete customer data to design customized products/service to meet their requirements. According to the above description, this study develops a hypothesis as follows:

H4a: *Interaction Orientation has a moderating effect on the relationship between CRM relational information processes and customer-based relational performance.*

CRM applications automate the customer-facing interactions between an enterprise and a customer based on an acknowledged fact that it costs three times as much to acquire a new customer as it takes to retain an existing customer (Vinod, 2007). Bradshaw and Brash (2001) suggested that CRM is a management approach that involves identifying, attracting, developing and maintaining successful customer relationships over time in order to increase retention of profitable customers. According to the above description, this study develops Hypothesis 4b as follows:

H4b: *Interaction Orientation has a moderating effect on the relationship between CRM relational information processes and customer-based profit performance.*

4. CRM System Readiness

CRM system readiness means that firms collaborate with CRM infrastructure, software, departments, and employees in order to implement CRM relational information processes effectively. These success factors for CRM implementation belong partly to organizational attributes and partly to technological attributes (Ramani& Kumar, 2008). CRM readiness consists of two dimensions, which are organizational readiness and technological readiness.

4.1 Organizational Readiness

Firms can not succeed in implementing CRM without internal function cooperation and adequate financial resources. Therefore, cross departments must be working together and supporting to each other, and in the meantime, senior managers also have to support the adoption of a CRM system. A customer-oriented culture is essential for the quality and extension of customer-knowledge creation and dissemination, as well as the implementation of a relationship-management strategy (Su, Tsai and Hsu, 2009). The appropriate collaboration of internal departments has positive effects on the implementation of CRM systems. Organizational readiness is assessed by financial and technological resources which

reflect whether or not a company has the capability to deal with the compatibility and consistency of a CRM system regarding firm culture, value, and preferred work practices (Grandon & Pearson, 2004). Moreover, Chan and Ngai (2007) stated that IT adoption includes the level of IT knowledge among top management, the level knowledge of individual learners, the level of IT use within the organization, the size of an organization, and its financial resources.

4.2 Technology Readiness

The use of CRM technology is expected to boost the ability of an organization to sustain profitable customer relationships by enabling information to be integrated and shared smoothly, thus facilitating more efficient and effective on firm-customer interaction, analysis of customer data, and customization of responses (Day, 2003).

A high level of technology readiness fosters the capturing of customer data, the analysis of customer information, and provides a coherent view of customers. Firms understand each customer's individual demands and adopt differentiation marketing based on these demands. Similarly, technology readiness supports the development of capabilities that result in a potential for competitive advantage.

At the heart of CRM is an organization's ability to leverage customer data creatively, effectively, efficiently, and based on these elements, to design and implement customer-focused strategies (Chang and Ku, 2009). Companies that are equipped with customer IT and knowledge have greater potential to make correct decisions, produce desirable products, services, and deliver value for customers. Reinartz et al. (2004) stated that firms that use technology in their organizations regard technology as a resource that supports the implementation of information processes. According to the above description, this study develops Hypothesis 5a as follows:

> H5a: *CRM system readiness has a moderating effect on the relationship between CRM relational information processes and customer-based relational performance.*

CRM information relates not only to current customers, but also to future potential customers to anticipate and to respond to their needs. As a management tool, CRM manages a company's relationship with its customers, thereby enabling the former to identify and attract customers and initiate appropriate steps towards the retention and identification of those customers that are profitable (Ryals, Knox, & Maklan, 2001). In order to obtain precise

information on targets or market segments and micro-segments, CRM enables organizations to reach high levels of profitability by using databases, data warehouses, data mining, one-to-one marketing, automated call centers and sales force automation (Maleki & Anand, 2008). According to the above description, this study develops Hypothesis 5b as follows:

H5b: *CRM system readiness has a moderating effect on the relationship between CRM relational information processes and customer-based profit performance.*

5. Conceptual Framework

The conceptual framework is shown in Figure 1. This study employed the CRM system relational information processes to discuss customer-based relationship performance and customer-based profits performance.

— Figure 1 is about here —

RESEARCH DESIGN

A qualitative approach consisting of individual in-depth interviews was adopted for the purpose of this study in order to understand the detailed operational processes and results of a CRM system within the firms being considered. Meanwhile, a confirmation of each dimension of the constructs in this study matched empirical practice and was, as a result, reasonable. After collecting abundant information from case studies, a questionnaire survey was adopted in order to further obtain the quantitative data for analysis. Eisenhardt (1989) and Yin (2003) addressed the idea of combinations of the qualitative and quantitative approach and suggested that it is precise and reliable.

Three companies participate in the case study. The first is 3C product retailer with extensive branches, Tsann Kuen Enterprise Co., Ltd. (TKE). The selected interviewee is the director of the Yung Hua branch, Mr. Daniel Yeh. The second one is a financial services company, Shin Kong Financial Holding Co., Ltd. (SKFH), which provides a variety of financial products. The chosen interviewee is a training lecturer of the firm, Mr. Kao. The third company is an insurance company, Kuo Hua Life (KHL), which focuses on life insurance. The selected interviewee is the sales manager in Southern Taiwan, Ms. Yang. In order to be concurrent with interview content, past literature, Internet data, and theory, this study is comprised of revised constructs and a questionnaire designed in terms of customer relational information processes, customer-based relational performance, customer-based profit performance,

interaction orientation, and CRM system readiness.

After conducting the interviews, questionnaires were delivered to firms that were in service industries with business-to-customer markets. The respondents were required to be either marketing or sales managers.

CASE ORGANIZATIONS

1. Case Studies Summary

From the findings that result from the interviews, this study found out that there were several common viewpoints. These interviewees were all in agreement with the adoption of sales representatives, call centers, and the other methods used to collect customer data. The collected data is all stored in a central database, analyzed by separate departments, and integrated to turn to useful information. Hence customer information remains stored in the databases, the front office is able to use the information to develop adequate marketing activities. Moreover, the three interviewees all considered customer satisfaction to be a very important evaluation criteria for their companies. A high level of customer satisfaction is equal to the willing of customers to sustain a long term relationship with firms. Satisfied customers communicate with positive word-of-mouth to their friends and relatives. These interviewees also indicated that the companies use customer information to segment the markets depending on customer value. Developing potential customers is also a main concern for all of the interviewees because new customers can expand the market size of firms.

The CRM system of the three companies was built in-house. In-house CRM systems can really match to the organizational structure and business model of each company. As a result, the companies prefer to develop CRM system in-house. The three companies have all applied their in-house CRM systems for over ten years. Thus, each company's CRM system has a user-friendly interface, and it is also compatible with their organizational structures.

Different perspectives from the interviewees were customer ownership which is the dimension of customer-based relational performance. Customers who purchase financial products such as insurance, funds, and other monetary related items are concerned about the financial statements of firms. However customers are rarely concerned about the financial well-being of firms when they purchase consumer products.

2. Revised Model: Based on Case Organizations

According to the findings from interview, this study discovered CRM system was regarded as a tool to assist daily business operations in chain stores. For instance, they adopted POS to record transactions of each customer such as amount of purchase, number of purchases, item purchased and so on. However, financial organizations interact with their customers through CRM system and sales representatives. Financial organizations collect each customer's up-to-dated information and provide individual customer with customized products/services. Although the chain stores and financial service are classified in service industry, the purpose of CRM system for two of them is different. The chain stores deem CRM system as a facilitator, whereas CRM system for financial organization is a medium for communicating with customers. However, customer ownership in customer-based relational performance was not supported in the case study. For example, customers visit to 3C outlets and purchase 3C products are not necessarily actively concern about the financial well-being of firms. The results of the case analysis reveal that not all customers are highly concerned about firms' financial conditions in every industry. Therefore, the study excluded the dimension of customer ownership from the conceptual framework.

DATA ANALYSIS

As discussed previously and following the case study, a questionnaire was designed consisting of six parts as follows: CRM relational information processes, customer-based relational performance, customer-based profit performance, interaction orientation, CRM system readiness, and background information. The questionnaire was based on seven-point Likert-scale response format that ranged from 1 (strongly disagree) to 7 (strongly agree). There were 48 items, including the background information items listed in the questionnaire. After that, a pilot test was conducted to evaluate reliability (Cronbach's alpha and an item-to-total correlation) and validity, and the aim was to ensure the readability and understandability of the questionnaire. Questionnaire items were revised based on the results of the pretest prior to conducting the formal survey.

Sample Characteristics

Paper-based questionnaires were distributed to eligible subjects in service industries such as retail, finance, and technology, among others. Meanwhile, 1000 questionnaires were distributed; there were 250 survey responses, and the response rates were about 25%. 209 surveys were considered valid for further analysis. The majority of the respondents were aged between 20 and 29 (49%). Most of them had a Bachelors degree or above (98%), and their

working experience ranged between one to five years (46%). The largest employment sample was from the financial industry (52%), and the most frequent position was (56%). Moreover, the majority of the respondents were working in the marketing department of their company (44.0%).

Data Analysis

The data was analyzed using SPSS 12.0 and AMOS 5.0. A CFA examines the adequacy of the measurement component of the proposed model and evaluates the discriminate validity of the constructs. Hierarchical regression was used to test the moderating effects. Item-to-total correlations were above 0.5 (0.57~0.877) except in the case of IC5, so IC5 was deleted. All of the remainder of the items had standardized factor loadings above the criteria of 0.5 (0.57~0.89).

In assessing reliability, although customer-based relational performance showed Cronbach's α and CR values slightly lower than 0.7, the value was still considered in the acceptable range (α= 0.680, CR= 0.657). Overall, all of the measures in this study can be regarded as having a satisfactory level of reliability. Convergent validity, the *t*-value of factor loading is commonly used to establish convergent validity. In this study, the fact that all factor loadings were relatively high and significant also provided strong evidence of convergent validity. Support for convergent validity was also demonstrated by the high average variance extracted (AVE) for all constructs. The AVEs of the five constructs in this study ranged from 0.465 (IC) to 0.743 (CBPP).

In Table 1, the change in chi-square of the constrained model is larger than 3.85 ($p < 0.05$). "A significantly lower χ^2 value for the model in which the trait correlations are not constrained to unity would indicate that the traits are not perfectly correlated and that discriminate validity is achieved."

— Table 1 is about here —

The standardized coefficients and significances for the hypothesized paths of the structural models and model fit indices are shown in Figure 2. The overall fit of model was excellent (chi-square, p= 0.003) and significant. The comparative fit index (CFI), the goodness of fit index (GFI), the adjusted goodness of fit index (AGFI) and the normed fit index (NFI) were 0.974, 0.95, 0.914, and 0.944, respectively. The root mean square error of approximation (RMSEA) was 0.063 (> 0.05), which fell in an acceptable range. The CRIP was positively

associated with the CBRP (γ= 0.652, $p < 0.001$) in support of H1. H2 predicted that the CRIP would lead to CBPP, was not significant (γ= 0.013, $p > 0.05$). H3 predicted that superior CBRP would lead to superior CBPP, was supported (γ=1.028, $p < 0.001$). Table 2 exhibits the results of path analysis and hypotheses testing.

— Figure 2 is about here —

— Table 2 is about here —

To test the hypotheses of the moderating effects (H4a and H5a,), hierarchical regression analysis was executed in this study to determine whether a significant interaction effect existed among CRM relational information processes (CRIP), interaction orientation (IO), and CRM system readiness (CSR) with customer-based relational performance (CBRP) as the dependent variable. To test H4b and H5b, hierarchical moderated regression was also used for analysis to determine whether a significant interaction effect existed among the CRIP, IO, and CSR, with customer-based profit performance (CBPP) as the dependent variable.

The results of hierarchical regression analysis are reported in Table 5. In the main effects-only model, the main effect of CRIP on CBRP was significant (β= 0.48, $p < 0.001$). The main effects of IO and CSR on CBRP (β= 0.292, $p < 0.001$; β= 0.356, $p < 0.001$) were all significant. The interaction orientation has a positive and significant effect on the relationship between CRIP and CBRP (β= 0.146, $p < 0.05$). Therefore, H4a is supported.

Customer-based profit performance as the dependent variable was used to examine Hypotheses 4b and 5b. The main effect of CRIP on CBPP was significant (β= 0.545, $p < 0.001$) The interaction terms of CRIP and IO had a non-significant effect on CBRP (β= -0.02, $p > 0.05$). Therefore, H4b was not supported. The interaction terms for CRIP and CSR had a non-significant effect on CBRP (β= -0.02, $p > 0.05$). Therefore, H5b was not supported.

— Table 3 is about here —

CONCLUSION AND SUGGESTIONS

Discussion

The results of this study refer to indications that CRM relational information processes directly affect customer-based relational performance, and then customer-based relational performance directly affects customer-based profit performance. Through the gathering, sifting, and analyzing of information regarding their customers, firms gain knowledge about the characteristics and behavior of every customer. Then, according to this knowledge about their customers, firms can develop customized actions oriented toward customers to meet the requirements of each customer on an individual basis. Therefore, well-collaborated CRM relational information processes facilitate an increase in customer satisfaction levels and positive word of mouth. Favorable customer satisfaction raises the level of return to extend and increase their amount of purchases, and the positive word of mouth attracts more new customers. The promotion of the value of customers therefore increases the sales and profit of firms.

However, it was found in this study that CRM relational information processes do not directly affect customer-based profit performance. This result does not seem to correspond to the research of Jayachandran et al. (2005), who investigated the association between relational information processes and customer relationship performance. This is because the concept of customer relationship performance in their study only explored customer satisfaction and customer retention. However, the definition of customer relationship performance in this study was more extensive. Not only was customer-based relational performance, which consists of customer satisfaction and word-of-mouth, investigated, but also customer-based profit performance was included. Additionally, the above results mean that CRM relational information processes must, through their influence on customer-based relation performance, also affect customer-based profit performance. CRM relational information processes stress the collecting and applying of information which is obtained from customers, so they only focus on the customer relationship levels. Through the operation of CRM relational information processes, the most direct influence toward firms is the customer's feelings and then their relationship with their customers. In other words, the more smoothly the CRM relational information processes are, the more the customer-based relation performance is promoted. Therefore, the levels of quality of CRM relational information processes are not so directly translated into financial outcome. After building favorable customer relationships, firms can retain more original customers, acquire more new customers and increase customer value and then realize the effects in profit performance. Therefore, the CRM relational information processes must through the mediator mechanism of relation-related performance

influence the ultimate financial-related performance.

Additionally, the effects of the two moderator constructs were partially significant. Interaction orientation had moderating effects on the influence of CRM relational information processes on customer-based relational performance. Interaction orientation is based on a customer-centric philosophy that includes information observed at the individual customer level, is recorded from each customer's transactions, opinions shared with customers, and predicted profitability. The adoption of interaction orientation on information management could foster the process of CRM information reciprocity, capture, integration, access and use more easily and more efficiently. Further, through an understanding of customers that corresponds to their preferences, firms establish favorable relationships with their customers. Retaining favorable relationships can be transformed into an improvement of higher levels of customer satisfaction and positive word of mouth.

As for CRM system readiness, although it had moderating effects on the influence of CRM relational information processes on customer-based relational performance, the effect was shown to be negative. CRM system readiness is the foundation of the accomplishment of the CRM information process. Complete technology infrastructure and specific mechanisms and rules for the implementation of tasks can assist with the collection and application of the information about customers and smooth the CRM information process. However, if the development and renewal of CRM system readiness is over complicated and fast, the steps of information processes must be updated continuously, so both the employees and organizations involved cannot correspond to the rapid growth of IT in real time. Therefore, CRM system readiness cannot be brought into full play to promote the establishment of favorable customer relationships and satisfaction. On the contrary, if the CRM system technology infrastructure is not complete, and the organizations do not provide the necessary support for executing CRM tasks, the building of relationships between a firm and its customers requires the assistance of complete CRM relational information processes. Therefore, when CRM system readiness is not so complete, the importance and influence of CRM relational information processes on customer-based relational performance are stronger.

However, the results in this study suggested that interaction orientation and CRM system readiness do not moderate the effect of CRM relational information processes on customer-based profit performance. The major reason for this was that the direct effect of CRM relational information processes on customer-based profit performance was not significant, so the moderating effects of interaction orientation and CRM system readiness on the relationship between them were also insignificant. Additionally, interaction orientation is

an intangible concept of interaction with customers. Customer-based profit performance is used to measure customer profitability, which is defined as tangible CRM benefits; moreover, customer-based relation performance is used to measure customer satisfaction and word-of-mouth, which is defined as intangible CRM benefits. Therefore, interaction orientation moderates the relationship between CRM relational information processes and customer-based relation performance but does not moderate the relationship between CRM relational information processes and customer-based profit performance, whose measurement character is different from interaction orientation.

Theoretical Implications

This study adopted more exact criteria to evaluate the performance of CRM. In the past, most research has employed financial indexes to measure CRM performance (Kumar and Reinartz, 2006); however financial outcomes can not entirely reflect customer attitude and behavior. Therefore, in order to actually explore customer value, customer-based performance, which is customer-centric, was adopted in this study. Further, this study found that CRM relational information processes first affect customer-based relational performance and then influence the customer-based profits performance. Past research only has investigated the influencing factors on the general performance of CRM; however, this study further divided the performance dimensions and showed that the completeness of CRM relational information processes must, through customer satisfaction and word of mouth, affect final profit performance. Therefore, CRM performance measures in this study were more comprehensive with regard to presenting customer value and more precisely pointing out the path of the quality of a CRM information system's influence on performance.

The role of the moderation of interaction orientation and CRM system readiness on the influence of the level of completeness of CRM relational information processes on the customer-based performance, which have been ignored in past research, were investigated in this study. The results of this study indicated that if the reciprocity, capture, integration, access and use of information are implemented at an individual level, firms provide customized products or services according to the needs and preferences of customers more easily. Fulfilling the requirements of customers improves customer satisfaction and word of mouth. Therefore, interaction orientation can foster the function of CRM relational information processes to enhance customer-based relational performance.

The results of this study suggested that higher CRM system readiness requires higher CRM

information processes. Overly complex and fast development of a CRM system make the CRM information processes hard to address, so firms cannot provide favorable and customized service to customers and cannot further strengthen their long-term relationships with their customers. On the contrary, when the CRM system infrastructure is not high quality, and the organizations do not provide training, rewards and rules corresponding to the CRM system, the influence of the completeness of CRM information processes with regard to retention and promotion of the relationship between the firms and its customers is higher. Therefore, a moderating effect of interaction orientation and CRM system readiness on the relationship between CRM relational information processes and customer-based relational performance was found.

Managerial Implications

There are several implications in this study for managers. This study showed that well-built information processes strengthen customer-based relational performance. Therefore, firms should develop information processes systemically to make firm collection, analysis, and use of customer information more precise. According to customer information that includes buying history, personal preferences, and other personal history, firms can offer customized products/services for each customer. In addition, firms can distribute resources adequately to profitable customers and reduce marketing costs spent on unprofitable ones. Through CRM relational information processes, firms can establish customer value management and then use resources more effectively and efficiently.

In addition, managers should thoroughly strengthen customer-based relational performance to promote the customer-based profit performance. When customers are satisfied with firm products/services, they tend to spread good word-of-mouth and further maintain long term relationships with firms. As a result of having a quality relationship with customers, firms can segment customers efficiently as well. Market segmentation can identify profitable and unprofitable customers. As different value driven from customers, firms can customize and personalize marketing activities and then exploit the full value of each customer to promote their profit performance.

This study showed that if there is a high level of CRM system readiness, it will not necessarily have a positive effect on the association between information processes and customer-based performance. When a firm that depends on its CRM system excessively, there is a negative effect, and the result is a case in which the CRM system is not user friendly or in which employees misunderstand the role that CRM plays in their organization. Therefore,

managers should build appropriate CRM technology systems and create complete rules, rewards and mechanisms to meet the developmental level of the CRM relational information processes and further promote customer-based performance.

REFERENCES

1. Ajzen, I. (1991), "The theory of planned behavior". *Organizational Behavior and Human Decision Processes,* Vol.5 No.2, pp.179-211.
2. Bradshaw, D. and Brash, C. (2001), "Managing customer relationships in the e-business world: How to personalize computer relationships for increased profitability". *International Journal of Retail and Distribution Management,* Vol.29 No.12, pp.520-529.
3. Chan, S.C.H. and Ngai, E.W.T. (2007), "A qualitative study of information technology adoption: How ten organizations adopted web-based training?" *Information Systems Journal*, Vol17 No.3, pp. 289-315.
4. Chang, H. H. and Ku, P. W. (2009), "Implementation of relationship quality for CRM performance: Acquisition of BPR and organisational learning", *Total Quality Management & Business Excellence*, Vol.20 No.3, pp.335-356
5. Chang, H. H. and Wong, K. H. (2010), "Adoption of e-procurement and participation of e-marketplace on firm performance: Trust as a moderator" *Information & Management,* Vol.47 No.5-6, pp.262-270
6. Day, G. S. (2003), "Creating a superior customer-relating capability", Sloan Management Review, Vol.4 No.3, pp.77-83.
7. Eisenhardt, K. (1989), "Building theories form case study research", *Academy of Management Review*, Vol.14 No.4, pp.532-550
8. Grandon, E. and Pearson, J. M. (2004), "E-commerce adoption: Perceptions of mangers/owners of small and medium sized firms in Chile", *Communications of the Association for Information Systems,* Vol.13, pp.81-102.
9. Jaramillo, F., and Grisaffe, D. B. (2009), "Does customer orientation impact objective sales performance? Insights from a longitudinal model in direct selling", *Journal of Personal Selling & Sales Management,* Vol29 No.2, pp.167-178.
10. Maleki, M., and Anand D. (2008), "The critical success factors in customer relationship management implementation". *Journal of Marketing & Communication,* Vol.4 No.2, pp.67-80.
11. Poddar, A., Donthu, N., and Wei, Y. (2008), "Web site customer orientations, web site quality, and purchase intentions: The role of web site personality", Journal of Business Research, Vol.62 No.4, 441-450.

12. Ramani, G., and Kumar, V. (2008), "Interaction orientation and firm performance", *Journal of Marketing*, Vol.72 No.1, pp. 27-45
13. Reinartz, W. J., and Kumar, V. (2003), "The impact of customer relationship characteristics on profitable lifetime duration", *Journal of Marketing,* Vol.67 No.1, pp.77-99.
14. Reinartz, W. J., Karfft, M., and Hoyer, W. D. (2004), "The customer relationship management process: Its measurement and impact on performance". *Journal of Marketing Research*, Vol.41 No.3, pp.293-305.
15. Ryals, L., Knox, S., and Maklan, S. (2001), "*Customer Relationship Management (CRM): Building the Business Case"*, Pearson Education, Edinburgh.
16. Sheth, J. N., Sisodia, R. S., and Sharma A. (2000), "The antecedents and consequences of customer-centric marketing", *Journal of the Academy of Marketing Science,* Vol.28 No.1, pp.55-66.
17. Spiller, J., Vlasic, A., and Yetton, P. (2007), "Post-adoption behavior of users of Internet service providers", *Information & Management*, Vol.44 No.6, pp.302–311
18. Su, C.H., Tsai, A., and Hsu, C.L. (2010), "The TQM extension: Total customer relationship management".*Total Quality Management & Business Excellence*, Vol.21 No.1, pp.79-92.
19. Vinod, B. (2007), "The continuing evolution: Customer-centric revenue management", *Journal of Revenue and Pricing Management,* Vol.*7* No.1, pp.27-39.

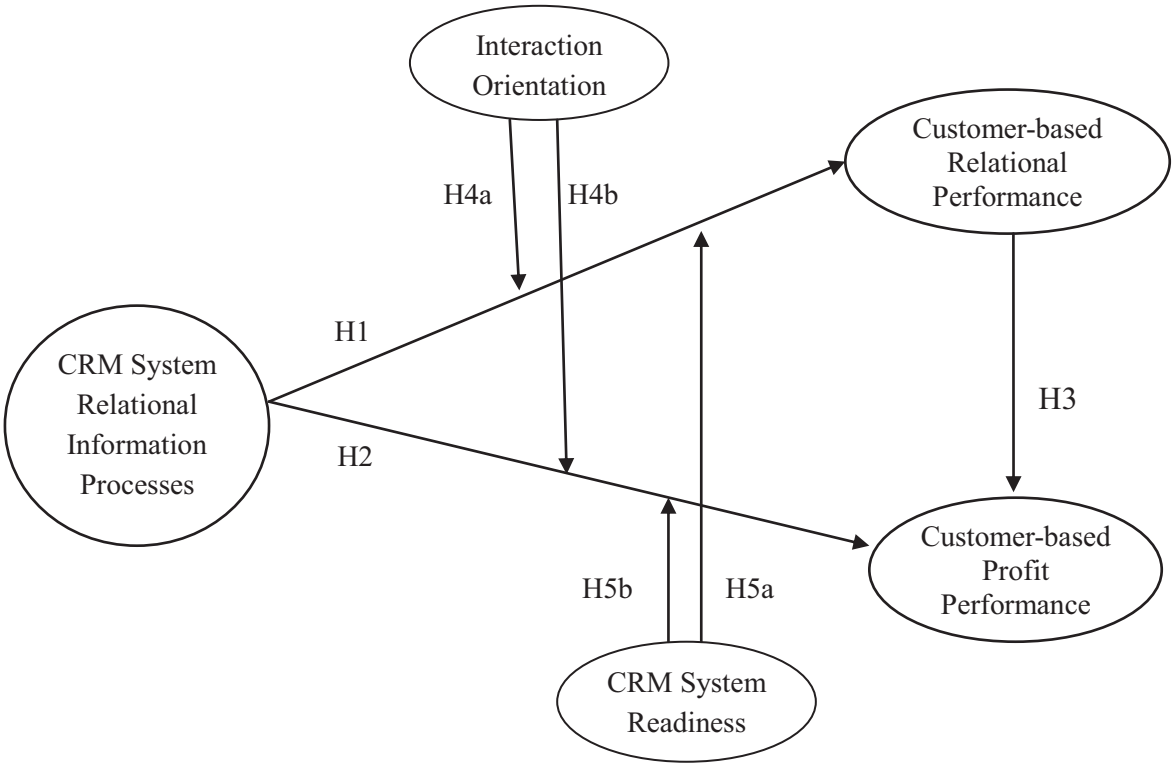


Figure 1 Conceptual Framework

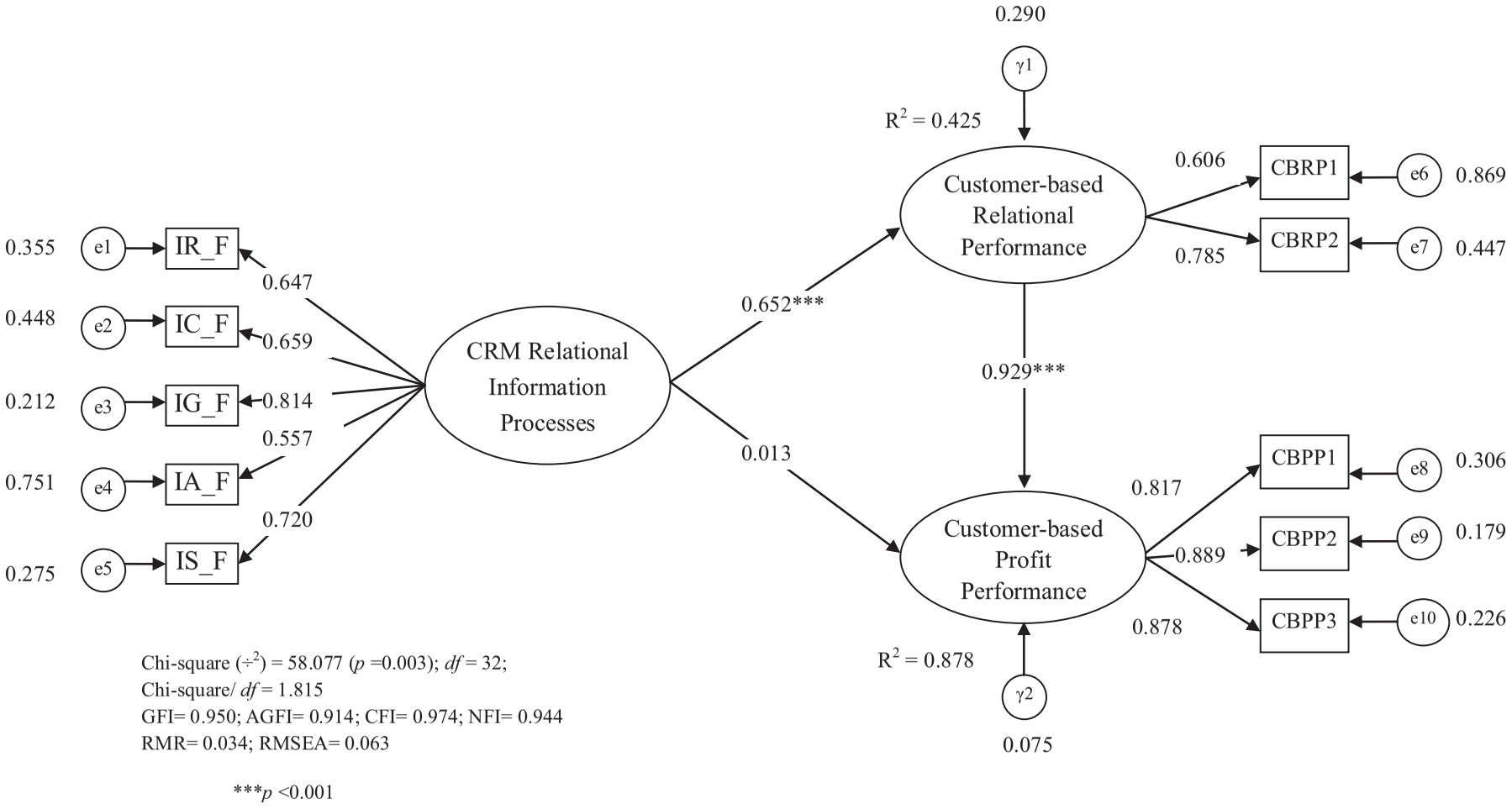


Figure 2 Results of Structural Equation Modeling (Main Effects)

Table 1 Results of Chi-square Difference Tests

Latent Factor 1	Latent Factor 2	Chi-Square[a]		Change in Chi-Square[b]
CRIP	CBRP	248.061	190.883	57.178
CRIP	CBPP	260.404	190.883	69.521
CRIP	Interaction Orientation	244.974	190.883	54.091
CRIP	CRM System Readiness	267.757	190.883	76.874
CBRP	CBRP	201.929	190.883	11.046
CBRP	Interaction Orientation	206.426	190.883	15.543
CBRP	CRM System Readiness	221.163	190.883	30.280
CBPP	Interaction Orientation	215.011	190.883	24.128
CBPP	CRM System Readiness	234.669	190.883	43.786
Interaction Orientation	CRM System Readiness	227.214	190.883	36.331

CRM Relational Information Processes (CRIP), Customer-based Relational Performance (CBRP), Customer-based Profit Performance (CBPP)

a. The chi-square for each latent factor 1 is on the left ($df = 95$), and the chi-square for each latent factor 2 ($df = 94$) is in the middle. On the left χ^2 value is constrained model, and on the right is unconstrained model.

b. For changes in chi-square greater than 3.85, $df = 1$.

Table 2 Path Analysis and Hypotheses Test

Hypothesis	Paths	Standard Coefficients	Results
H1	CRIP → CBRP	0.652***	Supported
H2	CRIP → CBPP	0.013	Not Supported
H3	CBRP → CBPP	0.929***	Supported

***p <0.001

Table 3 Results of Hierarchical Regression

Dependent variable	**CBRP (H4a and H5a)**			**CBPP (H4b and H5b)**		
Predictor variable	Model 1 (β)	Model 2 (β)	Model 3 (β)	Model 1 (β)	Model 2 (β)	Model 3 (β)
Main effects						
CRIP	0.480***	0.108	0.11	0.545***	0.189**	0.193**
IO		0.292***	0.294***		0.307***	0.31***
CSR		0.356***	0.359***		0.313***	0.314***
Interactions						
CRIP×IO			0.146*			-0.02
CRIP×CSR			-0.222**			-0.032
R^2	0.231	0.424	0.458	0.297	0.474	0.476
Adjusted R^2	0.227	0.416	0.444	0.293	0.466	0.463
F	62.106***	50.384***	34.279***	87.245***	61.504***	36.884***
ΔR^2	0.231	0.194	0.033	0.297	0.177	0.002
ΔF	62.106***	34.479***	6.25**	87.245***	34.51***	0.397
VIF	1	1.693~1.781	1.498~1.782		1.693~1.781	1.498~1.782

Interaction orientation (IO), CRM system readiness (CSR)

β is standardized coefficient, *p <0.05, **p <0.01, ***p <0.001,

Note: This study estimated the following equations using least squares regression to test hypotheses.

Model 1: CBRP = β0+β1CRIP+ε1

Model 2: CBRP= β0+β1CRIP+β2IO+β3CSR+ε2

Model 3: CBRP= β0+β1CRIP+β2IO+β3CSR+β4CRIP×IO +β5CRIP×CSR +ε3

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

PRODUCT QUALITY IMPROVEMENT THROUGH RESPONSE SURFACE METHODOLOGY : A CASE STUDY

HE Zhen, College of Management and Economics, Tianjin University, China, zhhe@tju.edu.cn, Tel: +86-22-87401783

ZHANG Xu-tao, College of Management and Economics, Tianjin University, China, lonewind1981@126.com

XIE Gui-qing, College of Management and Economics, Tianjin University, China, cindy.xie@hotmail.com

ABSTRACT

Purpose *– The paper aims to improve the key quality performance of the terminal of earphone in an electronic company.*
Design/methodology/approach *– Sequential experimental designs are employed. Significant input variables are found trough a full factorial design. Then a response surface model is constructed considering curvature in the linear model.*
Findings *– Optimized key input variables' parameters are found using the response surface model. The key quality performance, coplanarity of the terminal of earphone has been improved.*
Research limitations/implications *– Instead of running a full factorial design in the first stage, a fractional factorial may be used to reduce experimental runs.*
Originality/value *– The methodology used in this case can be easily extended to similar cases.*

Keywords quality improvement, design of experiments, response surface methodology, central composite design, parameter optimization

INTRODUCTION

Response surface methodology (RSM) is a collection of statistical and mathematical techniques useful for developing, improving, and optimizing products and processes. The most extensive applications of RSM are particularly in situations where several input variables have potentially influence on some performance measures or quality characteristics of the product or process. RSM initiates from design of experiments (DOE) to determine the factors' values for conducting experiments and collecting data. The data are then used to develop an empirical model that relates the process response to the factors. Subsequently, the model facilitates to search for better process response, which is validated through

experiments. The above procedure iterates until an optimal process is identified or the limit on experimental resources is reached. RSM is a very important tool for product and process improving in the improvement phase of Six Sigma Management.

Company A is an electronics enterprise in Tianjin, which engaged in supplying many kinds of electronic connectors for Motorola mobile phone division. In the supplying process, the company often received feedback complaints from customers. One kind of earphone named AJR45 had defect of bad echo caused by large coplanarity of the terminal. In order to improve the quality of products and reduce quality cost, the company adopted the one-factor-at-a-time (OFAT) approach and just selected the best existing experiment conditions as the optimal operating conditions. As we know, OFAT does not work well for process optimization if there are interactions among input variables. The solution by OFAT was not optimal in practice. The article presents a systematic solution to this problem through sequential use of experimental design to minimize the coplanarity and thus improve product quality.

LITERATURE REVIEW

Experimental design is widely used in manufacturing (Mukherjee & Ray, 2006; Sharma & Yadava, 2013; Koleva and Luchkov, 2005). C F Jeff Wu and Michael S Hamada(Wu & Hamada, 2009) classify experimental problems in to five broad categories according their objectives: treatment comparisons, variable screening, response surface exploration, system optimization and system robustness. RSM is a critical technology in developing new processes, optimizing their performance and improving the design and/or formulation of new products (Box et al,2005; Myers and Montgomery, 1995; Sefa-Dedeh, et al 2003). Myers and Montgomery (1995) also point out that most applications of RSM are sequential in nature. A screening experiment or a first order model is conducted first to identify important input factors. If the there is strong curvature exists and the first order model is not adequate, a second model or response surface model is needed. Cihan M.T. et al construct response surface for compressive strength of concrete through sequential design of a 2^{7-4} fractional factorial and then a D-optimal design (Cihan, Güner & Yüzer, 2013). He et al (2009) use sequential experimental design to improve the isolation of the fused biconical taper wavelength division multiplexer. In this paper, we design a full factorial experiment to find the important factors and a response surface model to optimize process parameters to improve coplanarity of the terminal of earphone.

THE FIRST STAGE EXPERIMENT

Most applications of response surface methodology are sequential in nature. That is, at first some ideas are generated concerning which factors or variables are likely to be important in the response surface study. This usually leads to an experiment designed to investigate these factors with a view toward eliminating the unimportant ones. This purpose of the experiment at this stage is to screen important factors or input variables.

Before starting experiment, we need to identify factors that affect coplanarity of the terminal by cause and effect analysis using fishbone diagram and cause and effect matrix. The coplanarity is mainly affected by the operating conditions of the gas riveting end machine. The factors are cylinder pressure, block height, decent speed, slot width. Table 1 gives factors and their levels in the experiment.

Table 1. Factors and their levels in experiment

Factors	Types	Levels	Are there center points
A (cylinder pressure)	variable	6-8 Pa	Yes
B (decent speed)	variable	2-4 s/mm	Yes
C (block height)	variable	13.1-13.7 mm	Yes
D (slot width)	variable	40-60 mm	Yes

Because there are less than five factors, we can use full factorial design in order to screen significant factors. We choose the 2^4 design with four center points to check the possible curvature. Table 2 shows the experimental arrangement. Note that the run order of the experiment has been randomized.

Table 2. Experiment arrangement for the 2^4 design (coded variables)

Run order	Center pt	A	B	C	D	Y
1	1	1	-1	-1	-1	0.069
2	1	-1	-1	-1	1	0.087
3	1	1	1	-1	1	0.071
4	1	-1	1	1	-1	0.095
5	0	0	0	0	0	0.082
6	1	-1	1	1	1	0.093
7	1	-1	1	-1	-1	0.086
8	1	1	1	1	1	0.083
9	1	1	-1	1	-1	0.081
10	1	1	1	1	-1	0.082
11	1	-1	-1	-1	-1	0.088
12	1	-1	-1	1	1	0.094
13	0	0	0	0	0	0.081
14	1	1	-1	-1	1	0.072
15	0	0	0	0	0	0.079
16	1	-1	1	-1	1	0.085
17	1	-1	-1	1	-1	0.093
18	0	0	0	0	0	0.081

Run order	Center pt	A	B	C	D	Y
19	1	1	1	-1	-1	0.073
20	1	1	-1	1	1	0.084

The experimental data in Table 2 were analyzed by Minitab. Table 3 shows the estimated effects and coefficients for response Y. From Table 3 we can find that factor A and C are significant with p-value<0.05, the interaction of A*C is significant with p-value=0.05.

Table 3. Estimated regression coefficients for Y (coded units)

Term	Effect	Coef	SE Coef	T	P
Constant		0.083500	0.000315	265.44	0.000
A	-0.013250	-0.006625	0.000315	-21.06	0.000*
B	-0.000000	-0.000000	0.000315	-0.00	1.000
C	0.009250	0.004625	0.000315	14.70	0.001*
D	0.000250	0.000125	0.000315	0.40	0.718
A*B	0.000750	0.000375	0.000315	1.19	0.319
A*C	0.002000	0.001000	0.000315	3.18	0.050*
A*D	0.001000	0.000500	0.000315	1.59	0.210
B*C	0.000250	0.000125	0.000315	0.40	0.718
B*D	-0.001250	-0.000625	0.000315	-1.99	0.141
C*D	0.000500	0.000250	0.000315	0.79	0.485
A*B*C	-0.001000	-0.000500	0.000315	-1.59	0.210
A*B*D	-0.000500	-0.000250	0.000315	-0.79	0.485
A*C*D	0.000250	0.000125	0.000315	0.40	0.718
B*C*D	-0.000000	-0.000000	0.000315	-0.00	1.000
A*B*C*D	0.000750	0.000375	0.000315	1.19	0.319
Ct Pt		-0.00275	0.000703	-3.91	0.03
S = 0.00125831, R-Sq = 99.57%, R-Sq(adj)=97.29%					

Note: * means that the p-value is less than 0.05, and the corresponding term is significant

To reduce the regression model, we need to delete those insignificant terms and keep A, C and A*C in the model. Table 4 shows the estimated effects and coefficients for response Y of the reduced model, and Table 5 shows the results of analysis of variance.

Table 4. Estimated regression coefficients for Y (coded units)

Term	Effect	Coef	SE Coef	T	P
Constant		0.08350	0.000331	252.480	0.000*
A	-0.01325	-0.006625	0.000	-20.03	0.000*
C	0.00925	0.004625	0.000	13.98	0.000*
A*C	0.00200	0.001000	0.000	3.02	0.009*
Ct Pt		-0.002750	0.001	-3.72	0.002*
S = 0.00132288, R-Sq = 97.64%, R-Sq(adj)=97.01%					

Note: * means that the p-value is less than 0.05, and the corresponding term is significant

Table 5. Analysis of variance for Y (coded units)

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Main effects	2	0.0010445	0.0010445	0.0005223	298.43	0.000*
2-way interactions	1	0.0000160	0.0000160	0.0000160	9.14	0.009*
Curvature	1	0.0000242	0.0000242	0.0000242	13.83	0.002*
Residual error	15	0.0000263	0.0000263	0.0000018		
Pure error	15	0.0000263	0.0000263	0.0000018		
Totol	19	0.0011110				

Note: * means that the p-value is less than 0.05, and the corresponding term is significant

Figure 1 shows the Pareto chart of the standardized effects, and Figure 2 shows the normal probability plot of the standardized effects. Both of them indicate that the effects of A, C and A*C are significant. But the curvature term is also significant. That means the first order model is not adequate. A second-order model for the significant variables A and C needs to be designed, and more experiments need to be done to fit the model.

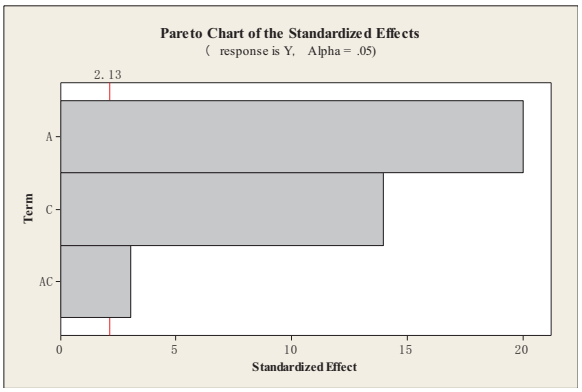


Figure 1 Pareto chart of the standardized effects

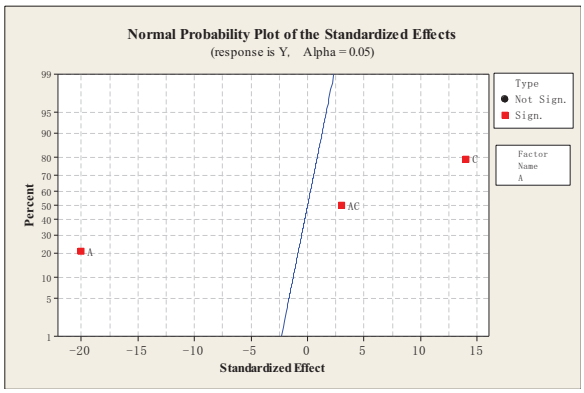


Figure 2 Normal probability plot of the standardized effects

EXPERIMENTAL DESIGNS FOR FITTING RESPONSE SURFACES

The first stage experiements results also shows that the lower pressure (factor A) and higher Height may yield possible lower coplanarity. Based on the engineering experience and steepest ascend analysis, we choose the high level of pressure to the high end of operating range, and the low level of height to the low level of operating end. Coplanarity was significantly reduced through the first stage experiement. Since there is possible curvature, a composite face-centered design (CCF) is used for the second stage experiments as shown in Figure 3, for two variables, there are four factorial points, five centre points and four axial points in the design.

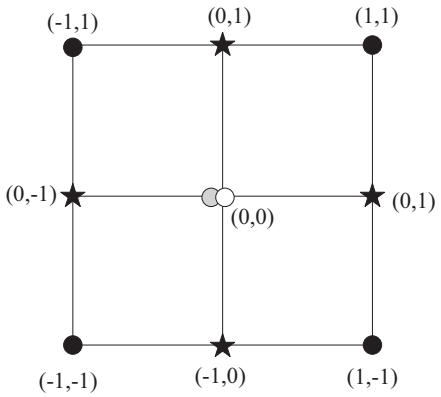


Figure 3 CCF design for two factors

Table 6 shows the experiment arrangement and results. In the second column, Pt type is the type of the experiment run. 1 stands for corner point, -1 stands for axial point, and 0 stands for center point. Also the run order of the experiment has been randomized.

Table 6. Experiment arrangement for the CCF (coded units)

Run order	Pt type	A	C	Y
1	0	0	0	0.029
2	-1	0	1	0.036
3	-1	1	0	0.022
4	1	-1	-1	0.031
5	1	1	1	0.039
6	-1	0	-1	0.022
7	0	0	0	0.024
8	0	0	0	0.029
9	1	1	-1	0.018
10	0	0	0	0.027
11	0	0	0	0.027
12	-1	-1	0	0.030
13	1	-1	1	0.033

Tables 7 and 8 show the analytical results. It can be seen from Table 7 that two-order term A*A is not significant and deleted from the model. The new results are shown in Table 9 and 10.

Table 7. Estimated regression coefficients for Y (coded units)

Term	Coef	SE Coef	T	P
Constant	0.026862	0.000856	31.368	0.000
A	-0.002500	0.000842	-2.969	0.021
C	0.006167	0.000842	7.324	0.000
A*A	-0.000017	0.001241	-0.014	0.989
C*C	0.002983	0.001241	2.404	0.047
A*C	0.004750	0.001031	4.606	0.002
S = 0.00206235, R-Sq = 92.81%, R-Sq(adj)=87.68%				

Note: * means that the p-value is less than 0.05, and the corresponding term is significant

Table 8. Analysis of variance for Y (coded units)

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Regression	5	0.000385	0.000385	0.000077	18.08	0.001
Linear	2	0.000266	0.000266	0.000133	31.23	0.000
Square	2	0.000029	0.000029	0.000014	3.36	0.095
Interaction	1	0.000090	0.000090	0.000090	21.22	0.002
Residual Error	7	0.000030	0.000030	0.000004		
Lack-of-Fit	3	0.000013	0.000013	0.000004	1.03	0.469
Pure Error	4	0.000017	0.000017	0.000004		
Total	12	0.000414				

Note: * means that the p-value is less than 0.05, and the corresponding term is significant

Table 9. Estimated regression coefficients for Y (coded units)

Term	Coef	SE Coef	T	P
Constant	0.026857	0.000729	36.833	0.000
A	-0.002500	0.000788	-3.174	0.013
C	0.006167	0.000788	7.830	0.000
C*C	0.002976	0.001073	2.773	0.024
A*C	0.004750	0.000965	4.924	0.001
S = 0.00192918, R-Sq = 92.81%, R-Sq(adj)=89.22%				

Note: * means that the p-value is less than 0.05, and the corresponding term is significant

Table 10. Analysis of variance for Y (coded units)

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Regression	4	0.000385	0.000385	0.000096	25.83	0.000
Linear	2	0.000266	0.000266	0.000133	35.69	0.000
Square	1	0.000029	0.000029	0.000029	7.69	0.024
Interaction	1	0.000090	0.000090	0.000090	24.25	0.001
Residual Error	8	0.000030	0.000030	0.000004		
Lack-of-Fit	4	0.000013	0.000013	0.000003	0.77	0.596
Pure Error	4	0.000017	0.000017	0.000004		
Total	12	0.000414				

Note: * means that the p-value is less than 0.05, and the corresponding term is significant

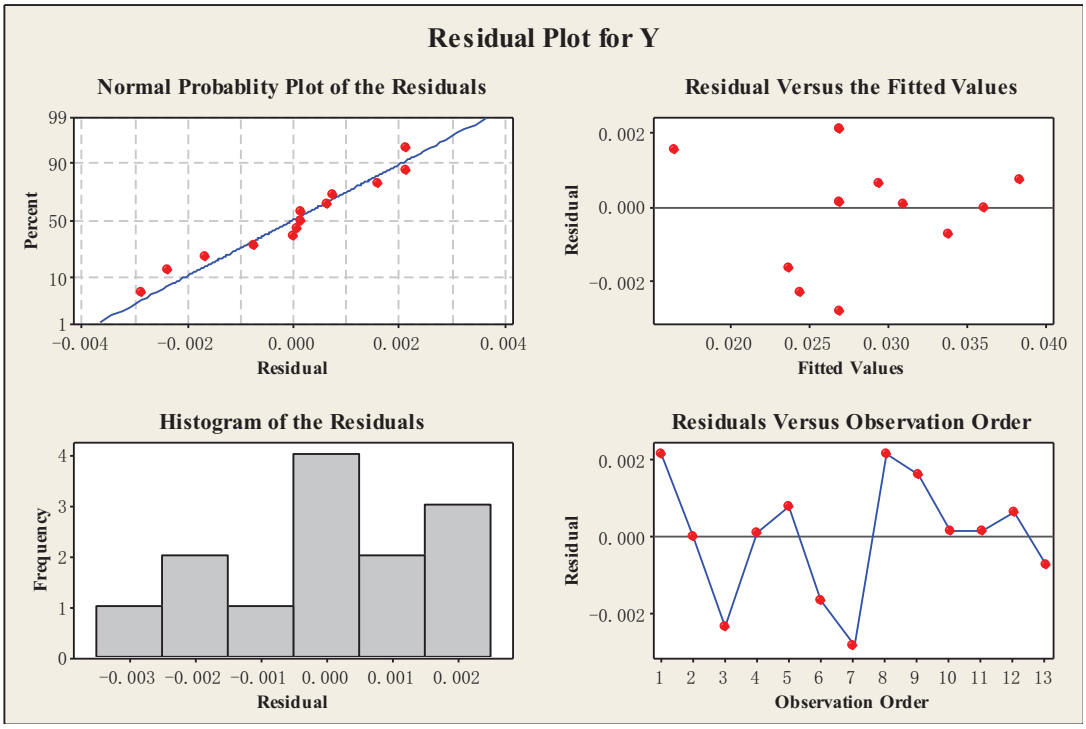


Figure 4 Four-in-One residual plots for response Y

The second-order model fit to the coded variables is

$$\hat{y} = 0.0269 - 0.0025A + 0.00617C + 0.00298C^2 + 0.00475A \times C \quad (1)$$

The model is fit well since R-Sq=92.81% and R-Sq(adj)=89.22%.

To check the validity of the fitted model we also conducted residual analysis (see Figure 4).

Results show that the residual is normally distributed, and equal variance and independence hold true.

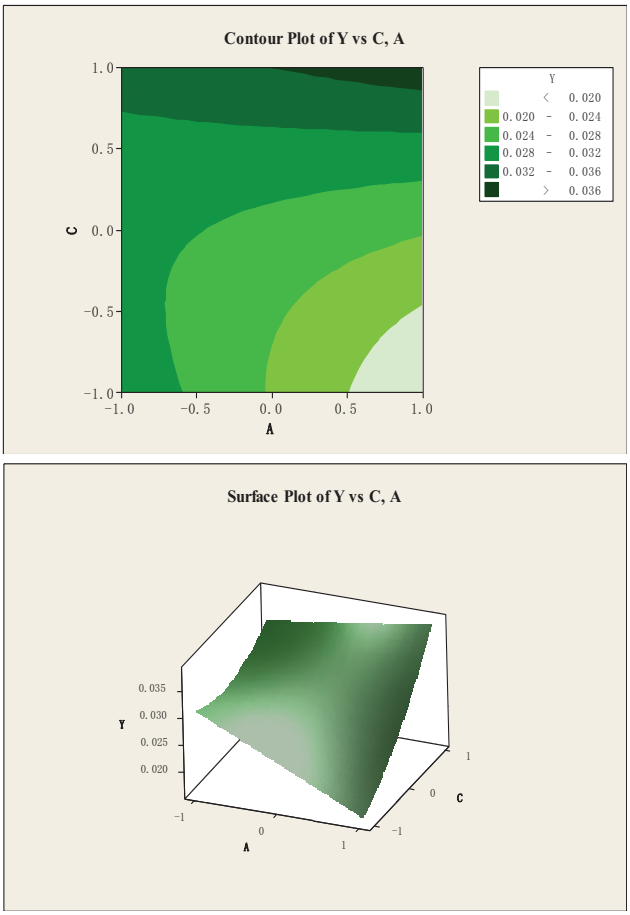


Figure 5 Contour plot and response surface

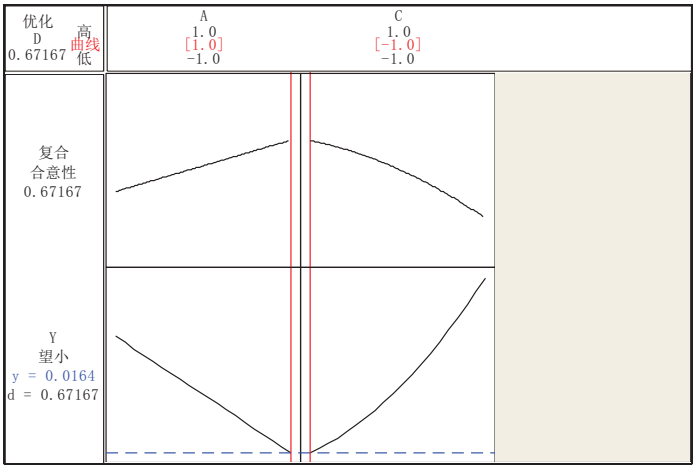


Figure 6 Response optimizer output

We can obtain the minimum point from model (1) directly, unfortunately, the minimum point is not at the region of operability. Hence we use computer to search the optimal point using

"response optimizer" of Minitab automatically. As shown in Figure 6, the optimal point is at A=1.0, C=-1, with the response Y=0.0164. At the same time, we estimate that at the optimal point the prediction confidence interval at α=0.05 is (0.0126, 0.0203). The coplanarity had a mean 0.0975 mm with a standard deviation 0.01mm before optimization, while it is 0.012-0.0203 mm after optimization. It is obvious that the coplanarity has been significantly improved. The experimental result is confirmed by confirmation runs.

CONCLUSION

The article presents a solution to optimize the coplanarity of the terminal of earphone, using designed experiments and response surface methodology. By designing experiments and analyzing experimental data, the optimum technical condition has been found, and the coplanarity has been improved.

ACKNOWLEDGEMENT

The research was sponsored by National Natural Science foundation of China (NSFC 70931004, 71225006).

REFERENCES

1. Box, G.E.P., Hunter, J.S. &Hunter, W.G. (2005). Statistics for experiments: design, innovation, and discovery (2nd ed.), New York:Wiley.
2. Cihan, M. T., Güner, A., Yüzer N.(2013), "Response surfaces for compressive strength of concrete", *Construction and Building Materials*, Vol. 40, pp.763–774.
3. He, Zhen, Han, Ya-Juan, Zhao, Shuang and Park, Sung H. (2009). "Product and process optimization design through Design of Experiments: A case study", *Total Quality Management & Business Excellence*, Vol.20, No.1, pp.107 -113.
4. Koleva, E., Vuchkov, I.(2005), "Model-based approach for quality improvement of electron beam welding applications in mass production", *Vacuum*, Vol.77, pp. 423–428.
5. Myers, R.H., Montgomery, D.C. (1995). *Response surface methodology: process and product optimization using designed experiments*. New York: Wiley.
6. Mukherjee, I., Ray, P. K.(2006), "A review of optimization techniques in metal cutting processes", *Computers & Industrial Engineering*, Vol.50, pp.15–34.
7. Sefa-Dedeh, S., et al (2003), "Application of response surface methodology for studying the quality characteristics of cowpea-fortified nixtamalized maize", *Innovative Food Science and Emerging Technologies,* Vol.4, pp.109–119.
8. Sharma, A., Yadava, V.(2013), "Modelling and optimization of cut quality during pulsed Nd:YAG laser cutting of thin Al-alloy sheet for curved profile" , *Optics and Lasers in Engineering*, Vol.51, pp. 77–88.
9. Wu, C. F. J., Michael S. H.(2009), *Experiments planning, analysis and optimization* (2nd edition), New York:Wiley.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE IMPLEMENTATION OF CUSTOMER RELATIONSHIP MANAGEMENT WITHIN TAIWANESE BANKS

Dr. Ying-Yueh Su, Chinese Culture University, Taiwan R.O.C.
yysu@sce.pccu.edu.tw

Dr. Yen-Ku Kuo*, Chinese Culture University, Taiwan R.O.C.
ykkuo@sce.pccu.edu.tw

Dr. Bang-Lee Chang, Chinese Culture University, Taiwan R.O.C.
blchang@sce.pccu.edu.tw
***corresponding author**

ABSTRACT

More and more organisations and companies have realised that they need to put their customers at the front and centre of their businesses, and to support an effective customer care process, while customer relationship management (CRM) becomes essentially about better managing all aspects of a company's relationship. CRM is not a new concept for organisations or companies. Nowadays, many businesses such as banks, insurance companies, and other service providers realise the importance of CRM and its potential to help them acquire new customers, retain existing ones and maximise their lifetime value. Particularly within the mass consumer banking sector, where customer numbers are large, these need to be managed systemically by information technology applications. Senior bank staffs, from seventeen Taiwanese banks, were interviewed about their understanding and performance of CRM. This finding discovers that CRM systems have been applied for at least two decades in Taiwanese banks. Specifically, banks often provided their CRM experience for their marketing strategies in order to evaluate valued customer and create customer relationship portfolios by understanding individual needs and preferences. However, the result also indicated that CRM has provided limited success expected. More specifically, the finding suggests that people-driven CRM is capable of the responsibility of the executives or front-line service staffs. Banks should apply not only the technological aspects of CRM, but also people-driven aspects in their marketing strategy. Customers, employees, and bank managers are all key parties in this process of CRM implementation.

Keywords: Customer relationship marketing, People-driven processes, Banks

INTRODUCTION

Over the past two decades, there has been an explosion of interest in customer relationship management (CRM) by both academics and executives. CRM was popularised in the 1980s and derived from an earlier concept called contact management (Ling and Yen, 2001; Goldenberg, 2006) which took place through contact channels (or media) to provide goods or services. More and more organisations and companies have realised that they need to put their customers at the

front and centre of their businesses, and to support an effective customer care process, which includes profiling customers, segmenting customers, researching customers, investing in technology, and managing customers (Brown, 2000).

CRM is not a new concept for organisations or companies. Nowadays, many businesses such as banks, insurance companies, and other service providers realise the importance of CRM and its potential to help them acquire new customers, retain existing ones and maximise their lifetime value (Wang and Ma, 2005; Blery and Michalakopoulos, 2006). Particularly within the mass consumer banking sector, where customer numbers are large, these need to be managed systemically by IT applications. Some Western studies (e.g. Ryals and Knox, 2001; Blery and Michalakopoulos, 2006) have demonstrated that CRM is intended to identify the most profitable customers and prospects, and devotes time and attention to expanding account relationships with customers. Meanwhile, implementation of CRM in the banking sector was considered by Blery and Michalakopoulos (2006), whose study focused on the evaluation of the critical satisfaction dimensions and the determination of customer groups with distinctive preferences and expectations in the private banking sector. In Taiwan, studies have showed that CRM is the feature hat banks most care about, however, but banks are short of knowledge and professional support for implementation of CRM (Chen and Popovich, 2003).

The purpose of this paper is intended to extend the understanding of the CRM performance in the consumer banking sector, especially with these mass consumer banking sectors, where customer numbers are large, these need to be managed systemically by information technology applications of CRM. More specially, this paper concerns the investigation of how CRM is implemented in the Taiwanese consumer banking sector in order identify alternative perspectives of CRM.

LITERURE REVIEW

Defining Customer Relationship Management

In the literature, there have emerged many definitions of Customer relationship management. However, to date, although CRM has become widely recognised as an important business approach, there is no universally accepted definition of CRM. The main differences among these definitions are related to the technological and relationship aspects of CRM. Some authors from a marketing background emphasise the technological side of CRM while others consider the IT perspective of CRM. The following section will discuss the definitions from the technological perspectives and marketing perspectives of CRM.

The Technological Perspectives of CRM

The increased accessibility of information technology (IT) coupled with increasingly sophisticated software allows for the capture of data from customers, its storage and its retrieval for marketing purpose in order to provide customised products and services. Ngai (2005) identifies 205 CRM articles published between 1992 and 2002 covering 89 journals, and implies that IT and Information System (IS) play an important role in the development and implementation of CRM. The three most popular topics addressed in IT and IS for CRM are ‘software, tools, systems (e.g.

decision support system, expert system, IS, enterprise resource planning, etc.), which can be viewed as technology-based applications to support the CRM process. These application systems should include database capabilities to collect and analyse customer information using statistical techniques such as data mining. Data mining plays a fundamental role in the overall CRM process and is a critical component in the CRM system (Rygielski et al., 2001). It helps transform customer data into useful information and knowledge. Customer information and knowledge is a company asset that must be managed. A deeper understanding of data mining and knowledge management in CRM is necessary in today's highly customer-centred business environment (Shaw et al., 2001).

Hence, from a technological perspective, CRM was claimed as the market place of the future and is undergoing a technology-driven metamorphosis (Peppers and Roger, 1995). Consequently, IT and marketing departments must work closely to implement CRM efficiently. Furthermore, there are two different interpretations of CRM in the literature to comprehend the technological perspectives of CRM: data-driven and process-driven CRM (Greenberg, 2004). Data-driven CRM focuses on CRM systems that integrate customer information using applications, interfaces, and automation tools (Greenberg, 2004). Process-driven CRM pays attention to the business integration process between people and systems which use data mining to enrich the process for the profiling of their customers (Little and Marandi, 2003; Greenberg, 2004). Mostly, the application of CRM is focused on technological application. For example, Battery (2003) asserts that CRM is only a technological infrastructure, comprised of both hardware and software, with the purpose of managing a large quantity of customer data. Hence, to most academics, CRM is technology-enabled RM (Little and Marandi, 2003, pg.198).

To summarise, from a technological perspective, CRM is a kind of technology approach to analysing customer behaviour for the purpose of better targeting customers, and so in this sense, 'CRM is essentially database or direct marketing' (Parvatiyar and Sheth, 2001). In fact, if CRM is to be successful handled, there has to be an aspect of marketing thinking in all business functions, and this may be one of the key aspects of the relationship perspective (Grönroos, 2007). The next section will discuss the marketing perspectives of CRM.

The Marketing Perspectives of CRM

From a marketing perspective, CRM is a managerial philosophy that has been defined as a combination of business processes and technology that seeks to understand a company's consumer behaviour. This viewpoint focuses on the relationship with the customer that integrates database knowledge within a long-term customer retention and growth strategy (Peppers and Rogers, 1995). For example, Jackson (1985, p.2) applies the individual account concept in industrial markets to suggest CRM to mean, 'Marketing oriented toward strong, lasting relationships with individual accounts'. In other business contexts, O'Neal (1989) and Doyle (1995) have proposed a similar view of CRM. Others, such as Swift (2001, p.12) consider CRM as an enterprise approach to understand and influence customer behaviour through by continue meaningful communications in order to improve customer acquisition, customer retention, customer loyalty, and customer profitability. Parvatiyar and Sheth (2001) indicates the potential of CRM to offer better customer service and to improve marketing effectiveness thorough a more focused approach. Kincaid (2003) emphasises the importance of viewing CRM as a comprehensive set of strategies for managing

those relationships with customers that relate to the overall process of marketing, sales, services, and support within the organisation. Information technology (IT) and information systems (IS) can be used to support and integrate the CRM process to satisfy the needs of the customer.

In summary, by integrating these definitions, this study proposes that CRM is about focusing on the needs and values of individual customers to maximise long-term profitability. This is achieved by attracting the right customers, enhancing life-time value through cross selling and up-selling, and by maximising the loyalty and retention of the right customers. It is about creating a new value with individual customers and sharing the benefits of the value over a lifetime of the relationship.

Additionally, most previous studies have focused on characteristics of CRM strategy, especially on the link between customer loyalty and profitability (Reinartz and Kumar, 2000). However, there is no clear indication of what specifically constitutes the implementation of CRM process. Some companies view CRM primarily as investments in technology and software, whereas others treat CRM more expansively and are aggressive in developing sound and productive relationships with customers. In addition, some companies have implemented CRM processes to a greater degree than others. Previous studies show that although the promises of how CRM can improve the performance of a business are many, the practical guidelines on how to design and implement CRM successfully are few, and that, as a result of this, practitioners have been struggling. Moreover, many banks are still following the traditional ways of marketing and only few banks are making attempts to adapt CRM. The lack of understanding on CRM is always a concern among the service providers especially banks. Lu et al. (2002) suggest that when implementing a CRM system, Taiwan's banking industry would normally focus on the customer-service system rather than on the overall strategies. Banks have their own way of managing their relationships with the customers. Therefore, what do these marketing managers in Taiwanese banks, who are in the front lines of implementing CRM think it is? This study provides empirical proof to fill these research gaps in the extant literature.

DATA COLLECTION AND ANALYSIS

Data collection took place between August 2010 and April 20012. 17 banks agreed to take part in and 34 in-depth interviews were conducted. All managers interviewed claimed to have knowledge of their marketing strategy, and typically occupied posts such as Marketing Manager or Vice President Personal Banking Division. An interview guide was used during the interviews which included questions asking what the interviewee understood by the term 'customer relationship management', what circumstances and how bank apply CRM to identify their customer segmentation and profitability. All interviews were taped, transcribed and analysed using thematic coding.

FINDINGS

The results of this study demonstrate that customer relationship management (CRM) systems have been applied for a long time in Taiwanese banks, so the finding data shows it's manifestly affected from both concepts and implementation of marketing strategies. Specifically, nearly all interviewees mentioned about CRM in their marketing strategies whether in relationship creation,

enhancement, or maintaining.

Banks Place over Emphasis on the Functions of CRM

This study finds that the majority of interviewees placed considerable emphasis on the functions of CRM such as allows gathering customer information and customer segments. The findings show that banks often provided their CRM experience within their marketing strategies implement in order to evaluate the valued customer and create the customer relationship portfolio by understanding individual needs and preference. However, some participants of this study indicated that CRM imitative have not reached the success expected from their bank because they regarded technology as an isolated element, without taking into account determining factors on which a relationship must support itself. For example, one interviewee stresses although CRM is so important, their bank consider different uncontrolled variables and makes the decision by human-being not just only with it.

Applying both Technology and People-driven CRM

Many interviewees also indicated their consideration about their disadvantage on lacking the knowledgeable staffs to manage and identify the mass customer information. In the literature on CRM, there are two kinds of interpretation of CRM: data-driven and processes-driven CRM (Greenberg, 2004), however, this study finds people-driven CRM in order to fill the lack of CRM which over focused on its technological facet. More specifically, this study suggests that people-driven CRM is capable on the responsibility of bank managers and operational staff in using nearly face-to-face communication and emotional contents establishment and their customer knowledge to process CRM with their customers. In other words, this kind of processes highlight on CRM on human side. Therefore, people-driven processes need that bank manager and service staff owning the capabilities of understanding and analysing customer knowledge to face and satisfy customer needs in CRM-using organisation.

CRM should be a Strategy not just a Solution

Many interviewees did however recognise that they required more employees to carry out data mining from CRM systems. In other words, people-driven processes need executives and front-line service staffs sharpening their capabilities and understanding with regards to manipulating, and analysing knowledge to face and satisfy customer needs in a consumer-oriented culture. These include processes that are difficult to implement or that cannot be carried out using technological solutions alone, such as planning customer strategy (Rigby et al., 2002), making critical decisions, and coping with customer problems (Chen and Popovich, 2003). Hence, bank managers conceive of CRM as a strategy rather than as a solution, and there still needs to be executives and front-line service staffs who understand customer needs and handle communications and responses.

Key Parties of CRM System

This study finds that many Taiwanese bank managers were applying CRM without any academic background, they still capitalised on a variety activities such as face-to-face interaction and emotional content linked with *guanxi* development (e.g. friendship) to understand customer needs and handle various communications and responses, especially when the greater customers' emotional needs, the greater the dependence on people-driven process in CRM. Therefore, this study suggests that customers, employees and bank managers should be the key parties in the CRM system. Not only bank managers and service personnel should take a proactive stance. Banks should pay more attention to the growth of knowledgeable customers and encourage their customers to engage actively in relationship development with their financial service provider.

DISCUSSION

Since many companies would like to better understand their customers, the focus of CRM turns to the implementation of sophisticated software for analysing different kinds of data. This situation has also been found in this study. Taiwanese banks place too much emphasis on the methods of analysis and adopt them as tools to provide value to customers. This is one of the key misinterpretations of CRM. Rigby et al., (2002), and Little and Marandi (2003) point out that more than half of all CRM initiatives fail to produce the anticipated results. Therefore, CRM is combination of people, processes, and technology that seeks to provide understanding of customer needs (Little and Marandi, 2003), to support a business strategy (Ling and Yen, 2001; Bull, 2003), and to build long-term relationships with customers (Gummesson, 2003). Although enabled by information system, CRM is not a technology solution (Rigby et al., 2002; Chen and Popovich, 2003). The system process cannot manage customer relations (Rigby et al., 2002; Chen and Popovich, 2003) because customer knowledge needs to be comprehended busy business managers and the face-to-face communication needs to be performed by front-line operation. Hence, the key processes are performed by human beings and required clear understanding of the goals and contents of key decisions and system-people interactions (e.g. Ling and Yen, 2001; Rigby et al., 2002; Chen and Popovich, 2003). In order words, companies are integrating operations and investing in information systems that share data from customers. The potential of CRM lies in its ability to help company increases the profits by identifying profitable customers and tailoring company offers to customer's needs, willingness to pay, and profitability.

Moreover, this study proposes the people-driven processes in CRM could provide a reference for planning effective RM for customer relationship and can supplement existing studies on data-driven and process-driven CRM. 'People-driven processes' in CRM emphasises that executive and service encounters in face-to-face interactions and customer knowledge to process CRM. The human side of CRM processes should receive greater attention in CRM studies.

REFERENCE

1. Batterly, R. (2003) *Leading through relationship marketing*, Tata McGraw, New Delhi Hill
2. Blery, E., and Michalakopoulos, M. (2006) 'Customer relationship management: a case study of a Greek bank', *Journal of Financial Services Marketing*, 11(2), pp.116-24

3. Brown, S.A. (2000) 'Customer relationship management: a strategic imperative in the world of e-Business, Ontario: John Wiley & Sons Canada, Ltd, pp.24-7
4. Bull, C. (2003) 'Strategic issues in customer relationship management implementation', *Business Process Management Journal*, 9(5), pp.592-602
5. Chen, I.J., and Popovich, K. (2003) 'Understanding customer relationship management', *Business Process Management Journal*, 9(5), pp.672-88
6. Doyle, P. (1995) 'Marketing in the new millennium', *European Journal of Marketing*, 29(13), pp.23-41
7. Goldenberg, B. (2006) 'CRM: the past and the future', *Customer Relationship Management*, 10(1), pp.18-31
8. Greenberg, P. (2004) CRM at the Speed of Light (3rd edn), McGraw-Hill Osborne Media
9. Grönroos, C. (2007) *Service Management and Marketing: Customer Management in Service Competition* (3rd edn), John Wiley & Sons, Ltd.
10. Jackson, B.B. (1985) *Winning and Keeping Industrial Customers*, Lexington, MA: Lexington Books
11. Kincaid, J.W. (2003) 'Customer relationship management: getting it right', NJ: Prentice Hall
12. Ling, R., and Yen, D.C. (2001) 'Customer relationship management: an analysis framework and implementation strategies', *The Journal of Computer Information Systems*, 41(3), pp.82-97
13. Little, E. and Marandi, E. (2003) *Relationship Marketing Management*, THOMSON
14. Lu, H. P.., Hsu, H. H., and Hsu, C. L. (2002) A Study of the Bank's Establishment on Customer Relationship Management, Published in 13th International Conference on Information Management , Taipei, Republic of China
15. Nagi, E.W.T. (2005) 'Customer relationship management research (1992-2002): an academic literature review and classification', *Marketing Intelligence and Planning*, 23(6), pp.582-095
16. O'Neal, C. (1989) 'JIT procurement and relationship marketing', *Industrial Marketing Management*, 18(1), pp.55-63
17. Parvatiyar, A., and Sheth, J.N. (2001) 'Customer relationship management: emerging practice, process, and discipline', *Journal of Economics and Social Research*, 3(2), pp.1-34
18. Peppers, D. and Rogers, M (1995) 'A new marketing paradigm: share of customer, not market share', *Managing Service Quality*, 5(3), pp.48-51
19. Rigby, D.K., Reichheld, E.F, and Schefer, P. (2002) 'Avoid the four perils of CRM', *Harvard Business Review*, 80(2), pp.101-9
20. Ryals, L. and Knox, S. (2001) 'Cross-functional issues in the implementation of relationship marketing through customer relationship management (CRM)', *European Management Journal*, 19(5), pp.534-42
21. Shaw, M.J., Subramanian, C., Tan, G.W., and Wedge, M.E., (2001) Knowledge management and data mining for marketing', *Decision Support System*, 31(1), pp.127-37
22. Wang, G. and Ma, N. (2005) 'Research on the application of customer relationship management in Chinese banking', *China-USA Business Review*, 4(3), pp.1514-37

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

APPLICAABILITY OF THE (Q,R)-MODEL IN MAINTENANCE METERIALS MANAGEMENT

Antti Puurunen*, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610, FI-90014, Finland, antti.puurunen@oulu.fi

Jukka Majava, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610, FI-90014, Finland, jukka.majava@oulu.fi

Hanna Kropsu-Vehkapera, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610, FI-90014, Finland, hanna.kropsu-vehkapera@oulu.fi

Pekka Kess, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610, FI-90014, Finland, pekka.kess@oulu.fi

ABSTRACT

Purpose: *The purpose of the research is to study the applicability of the (Q,R)-model in inventory management of the maintenance materials in investment intensive industry companies. The objective of the research is to answer the following research questions: 1. What is the applicability of (Q,R)-model in maintenance materials inventory management? What are the main challenges, if any, in applying the (Q,R)-model in maintenance materials inventory management?*
Design/methodology/approach: *The research is a case study using data-analysis in answering the research questions. The case company is a Finnish steel manufacturer.*
Findings: *The study results show that inventory levels are not controlled by the parameters of the (Q,R)-model which causes unnecessary stocking. One mechanism which causes inventory uncontrollability is also identified.*
Research limitations/implications: *The research is based on a single case study. The maintenance management of the case company is similar to many other companies in the basic industries, but the applicability of the findings require wider empirical research.*
Practical implications: *The paper suggests material managers to address more attention to the structure of the internal maintenance materials supply chain. Recommended actions for reducing the share of the uncontrollable material flows, include, for example, returns to the suppliers, better scheduled maintenance demand forecasting, and adding repairable transaction to the Computerized Maintenance Management System (CMMS).*
Originality/value *– This paper presents novel results from maintenance management in process industries. The research indicates that widely applied (Q,R)-model is not a feasible method in all maintenance material applications.*

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

Keywords – Maintenance materials inventory, spare parts, inventory management, inventory control.

INTRODUCTION

During the past decades the capital tied to the production equipment has increased. As a result, the importance of maintenance management, and therefore maintenance materials supply chain management, to the company's business has grown. In today's industrial companies maintenance costs can represent the largest part of operational budget (Garg and Desmukh, 2006), and the value of capital tied in maintenance materials inventories can be tens of millions euros (e.g. Porras and Dekker, 2008).

Maintenance can be determined as activities, either technical or administrative, needed to maintain and restore the desired operation condition of the production equipment or any other physical asset (Muchiri et al., 2011). Maintenance activities are typically divided into two fundamental types – reactive and proactive maintenance (Kothamasu et al., 2006). Reactive maintenance can be seen as corrective activities which are carried out only after the equipment breakdown, and proactive as activities which are carried out before the breakdown. The taxonomy of maintenance activities is more clearly shown in Figure 1. In addition, the activities aiming to reduce the future need of maintenance or to improve the operation of the equipment have been, in some cases, specified as a class of aggressive maintenance. In this study, the aggressive maintenance does not fit to our earlier stated maintenance determination (Swanson, 2001).

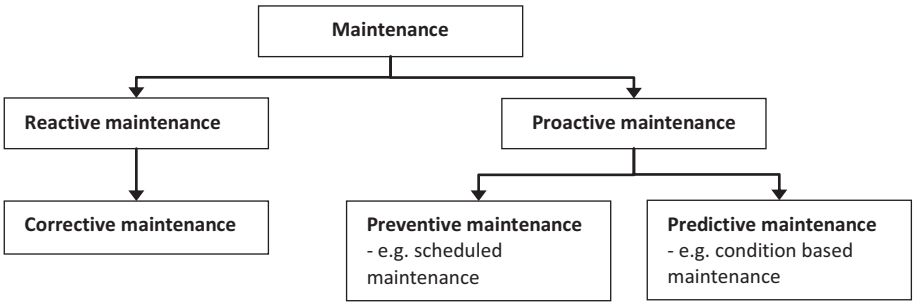


Figure 1. Taxonomy of maintenance activities (modified from Kothamasu et al., 2006).

Supply chain management of maintenance materials, i.e. spare parts and consumables needed for the maintenance, is essential for ensuring the operational reliability. Unavailability of maintenance material can cause extended downtime, which in critical process phase leads to high costs. In addition to the high availability requirements, other characteristics of maintenance materials are sporadic demand and relatively high price of individual item (Huiskonen, 2001).

Management of the supply chain, and especially inventory management, is challenging because of the nature of maintenance. For proactive maintenance, it may be possible to procure materials to arrive just when needed to avoid unnecessary warehousing. For corrective maintenance, stock

outs can cause significant production loss and a safety stock is typically needed (Kennedy et al., 2002). The function of the inventory therefore derives from the needs of the maintenance and the size of the inventory depends on the production equipment's maintenance policy. These aspects differentiate the management of maintenance materials inventory from other manufacturing-related inventories.

Despite special characteristics, the maintenance materials inventory management typically relies on traditional inventory management theories and practices, e.g. Economic Order Quantity (EOQ), developed by Harris (1913), and reorder point method with fixed or non-fixed order quantity. In industrial maintenance context, the inventories, or at least part of the inventory items, are often controlled by continuously reviewed fixed order quantity (Q) and reorder point (R) inventory model, i.e. (Q,R)-model (Figure 2).

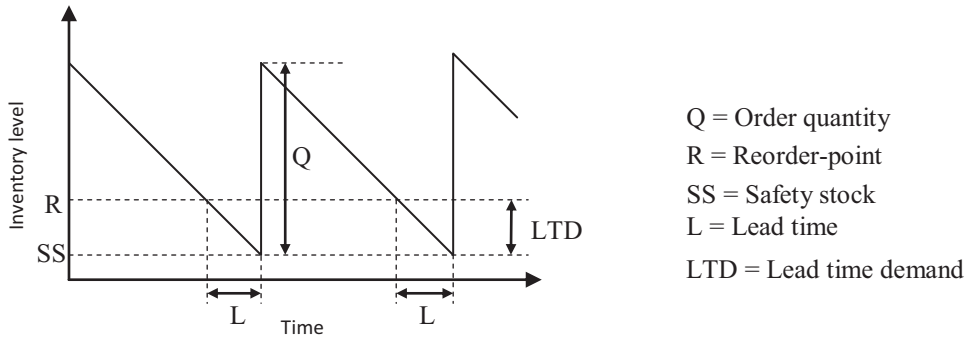


Figure 2. Logic of continuously reviewed fixed order quantity inventory model (Tersine, 1984).

In the (Q,R)-model, the replenishment orders are fully controlled by the parameters Q and R. The R expresses when to order and the Q expresses how much to order. Buyer needs to decide only the supplier. Because the model controls the amount and frequency of inbound material flow to the inventory, the inventory optimization is typically seen as optimization of the parameters (e.g. Chang et al., 2005). However, not enough attention has been addressed to the (Q,R)-model's applicability to the maintenance context, where other inbound sources besides replenishment orders may exist. These include, for instance returns.

In this research the applicability of the (Q,R)-model, utilized in the case company's inventory management, is analyzed. The main aim of the study is to research whether the applied model can manage the inventory level in a sound way and what is needed for better control of the inventory. The applicability is analyzed by answering following research questions:

1. What is the applicability of (Q,R)-model in maintenance materials inventory management?
2. What are the main challenges, if any, in applying the (Q,R)-model in maintenance materials inventory management?

LITERATURE REVIEW

In the early 2000s, the research of maintenance materials supply chain management focused on its differences to the conventional logistics. At that time, the maintenance materials were identified to have characteristics, e.g. sporadic demand, high service-level requirements and high price, which affect the inventory management (Huiskonen, 2001). More recently, the demand of the maintenance materials has been linked to the maintenance policy of the production equipment (Wang and Syntetos, 2011) and several studies about joint optimization of maintenance and inventory emerged (Van Horenbeek et al., 2012).

In the inventory management research generally, the (Q,R)-model is widely applied in the last decades and lot of extensions have been made to adapt the model better to its context, e.g. demand uncertainties and backordered/lost-sale stock-out policy (Williams and Tokar, 2008). The models have evolved to be context-specific due to the different requirements in operating environments, e.g. deteriorating items, supply chain structures, etc.

In industrial maintenance, the structure of the supply chain differs from the assumptions of the (Q,R)-model. In addition to the obvious supplier-inventory-customer material flow, also other flows exist. For example, some spare parts may be in the internal repair cycle, where used parts are recovered for future use by the plant's repair shop. Also unused spares can be returned to the inventory. Driessen et al. (2010) refer to these other flows as part return streams. Driessen et al. (2010) propose a delay time between the material request and demand registration; if the request is not justified, it can be returned to the inventory within the delay and no new purchase order is triggered. In the model, only external suppliers replenish the inventories.

Wang and Syntetos (2011) continued contributing to this phenomenon by making a distinction between material requests arisen from the proactive or reactive maintenance. For reactive maintenance, the requested amount is typically deterministic but the moment when the need arises is stochastic, while, for proactive maintenance, requested amount is stochastic but the moment when the need arises is deterministic. Practically, this means, that from proactive maintenance activities, returns of excess materials to the inventory may cause a significant source.

Product returns and their impact on the inventory management have been studied widely from reverse logistics point of view. Fleischmann et al. (1997) discuss a system, where a certain share of demand returns to the inventory as recovered products. A clear distinction can be made between the recovered returns and the unused returns, and for repairable maintenance materials management, e.g. the METRIC-model (Sherbrooke, 2004) can be applied.

Unused material returns are a common challenge especially in catalogue/internet mail order retail business, due to the customers' legal right to return the product without expenses. In that context generally, Mostard and Teunter (2006) observed the return rate to be approximately 35-40 % of deliveries, and applied the newsboy problem to it with promising results.

RESEARCH PROCESS

The research process of the study is shown in Figure 3.

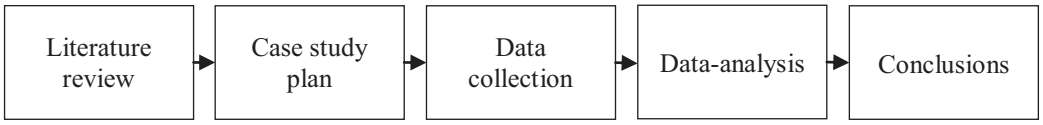


Figure 3. Research process.

The study started with reviewing the relevant literature. The recent research of maintenance materials supply chain management, (Q,R)-inventory model and product returns were reviewed. The second phase is the planning of the case study.

The research aims to answer whether the assumptions of the (Q,R)-model are realistic in the maintenance context. For this purpose, a case study was seen an appropriate research strategy. The research strategy was preferred because of the research environment. The focus of the study is on a contemporary phenomenon, i.e. maintenance materials supply chain, within the real-life context. The design of the study is an embedded single case design. Not much can be said about the functionalities of the inventory at inventory level, so we pay attention to the subunits, e.g. inventory items and transactions. A major risk of this kind of study is that the original target of the study becomes the context. To avoid the research becoming an inventory item and transaction study, the results of subunit analysis are presented in relation to the whole inventory. (Yin, 2003.)

The rationale for the selection of the case company is a mix of critical and typical case. From the maintenance point of view, the maintenance-intensive company represents the critical case. Maintenance has particularly significant impact on the case company's business and therefore it can be assumed to be well managed. From heavy process industry, or computerized maintenance management system (CMMS) point of view, the company is assumed representing a typical case. (Yin, 2003.)

The data collection from the CMMS includes all inventory transactions recorded in 2011 for all inventory items determined as maintenance materials. Practically, two databases, inventory item database limited to maintenance materials and inventory transaction database were combined by using the item identification code as a join. The current inventory level and current control parameters were available from the inventory item database. In the analysis phase, the MS Excel and MS Access were used. The item selection is more detailed presented in the case company section.

The current state of the inventory controllability is analyzed by comparing the contemporary inventory level to the situation where the inventory level is controlled by the control parameters. After analyzing the inventory levels, the transaction types are investigated to identify different material channels and their impact and significance to the inventory value.

Case company

The company under research was a Finnish steel manufacturer listed on the Helsinki Stock Exchange. The company currently has operation units globally, but its largest steel mill, where the study was conducted, is located in Finland.

At the time of the study (2012), for maintenance materials, there was one main storage facility and there were nine smaller production-unit-specific storage facilities at the site. There were almost 40,000 items kept in stock, and the value of the capital tied in these inventories was tens of millions euros. In addition, there were the vendor managed main inventory and the smaller satellite inventories, also managed by the vendor, around the site. However, the value of material replenishments and consumption was highly concentrated in the mill's main storage facility.

The actual stock control is based on a fixed order quantity and reorder-point method, where a new purchase request with the stated quantity takes place every time the storage level reaches the reorder point. Responsibility for these item-specific control parameters was designated to a relevant department. Usually this department was the one using the item, or the material management department, which was also responsible for the management of all storage facilities at the site. No systematic or instructed procedure existed for the determination or the optimization of the parameters.

The order-quantity and reorder-point optimization was thought in the company to be a primary development effort in inventory management because of the previous attempts to reduce the tied capital had been unsatisfactory. However, before the optimization project the company wanted to have a comprehensive picture about the factors affecting to the inventory levels currently.

In the CMMS, the inventory items are classified according to Table 1. In the company, maintenance materials were seen including the physical items in the classes 2-7. 38 774 inventory items existed after service items were excluded. Obviously, maintenance materials are not a homogenous group of items and demand patterns and supply characteristics vary between items.

Table 1. Material classes in the CMMS.

Class	Name
0	Basic materials
1	Refractories
2	Consumable machine parts
3	Piping and HVAC consumables, hydraulics and pneumatics
4	Electrical devices, instruments and spare parts
5	Electrical installation consumables and electronic components
6	Power transmission, lifting and moving devices
7	Machine and construction elements
8	Typed structures
9	Tools, safety and security equipment

RESULTS

1. Inventory level controllability

In (Q,R)-model, the inventory level is controlled by the parameters. In table 2, the control parameters (Q) and (R) with item's price and current inventory levels (CL), are shown for four items. The stock expresses how many years the current inventory level would meet the demand if the future demand is projected from the past five and half year consumption. For all of these items, the inventory level is relatively high in the light of the past consumption and current control parameters.

Table 2. Example maintenance inventory items.

Item ID	Q	R	Price	CL	Stock
666388	*11.67*	*10.00*	*327 €*	*476*	*12.5*
173427	*3.50*	*4.00*	*20 660 €*	*9*	*2.60*
364265	*0.08*	*1.00*	*5300 €*	*6*	*4.71*
302901	*0.08*	*1.00*	*3590 €*	*7*	*19.3*

Current inventory levels (Table 2) shows, that the inventory levels do not follow the parameters. Consequences of the inventory uncontrollability are evaluated by estimating the inventory level in the situation where the inventory level is fully obeying the control parameters. In the (Q,R) context, the average inventory level can be approximated by using e.g. Hadley-Whitin's (1963) method. However, it is unknown, how well the instantaneous view describes the average inventory at item level. Another restriction of the use of the Hadley-Whitin's expression is that the value of safety-stock remains unknown. Therefore the portion of overstock has been estimated in two ways:

Method 1. *Overstock = CL - (Q + R), and*
Method 2. *Overstock = CL - (½Q + R).*

For example, item's 666388 (Table 2) overstock by using method 1 can be calculated as 454.33 units which equals 148 566 € or 95.4% (Overstock/CL). By using method 2 the overstock equals 460.17 units which is 150 474€ or 96.7% of total inventory value of the item.

In Table 3, the overstock of all inventory items has been added together and shown as a share of the total inventory value. Totally, the inventory level exceeds the maximum level (Method 1) for every fourth item and the value tied to the exceeding share is 19.1% of the total inventory. The average level (Method 2) exceeds for 42% of items and the exceeding value is 36.2% of total inventory.

Table 3. Shares of overstock.

Estimation method	**Method 1**		**Method 2**	
	Items	**Overstock**	**Items**	**Overstock**
Results	9312	19.1 %	16295	36.2 %

2. Causes of overstocking

The study of the mechanism, which is causing the excess in inventory levels, started with the identification of the transaction types. In the CMMS, there were 17 different types of transaction to get the materials into or out of the inventory. Those transactions are shown in the Table 4.

Table 4. Inventory transaction types in CMMS.

	Description	**Out transactions**	**Description**
Material transactions:			
Receipt of purchase order	*Arrival of purchase order triggered from R*	**Returns to supplier**	*Return of non-conformance goods*
Return of pick-up	*Return of material due to the oversized pick-up*	**Pick-ups for consumption**	*Material pick-up for maintenance activity*
Transfer in	*Material transfer from other storage facility*	**Transfer out**	*Material transfer to other storage facility*
Return without order	*Material return which are not related any pick-up*	**Cancellation of return without order**	*Cancellation of return without order*
Stock-taking, gain	*Stock-taking correction > 0 €*	**Stock-taking , loss**	*Stock-taking correction < 0 €*
		Scrap	*Material pick-up for to be scrapped*
Return from sale	*Return of material on sale*	**Pick-up for sale**	*Material pick-up for to be sold*
Corrections:			
Manual price change		**Manual price change**	
Transfer correction		**Transfer correction**	

Material can be brought to the inventory with receipt of purchase order; returns to inventory; transfers in; returns without order; stock-taking or returns from sale transaction. Receipts of purchase orders (RPO) were caused by conventional purchases triggered from the re-order point. Returns without order (RwO) resulted from the returns of the direct purchases which can be caused by scheduled maintenance or investments, but also in-house reparable spare parts were brought to the inventory with this transaction. Return of pick-up was the way to return the excess material caused by oversized amount of pick-up. Transfer transactions are for the material transfers between different storage facilities.

Materials can be moved out of the inventory for returns to supplier; pick-up for consumption (PU); transfer out; cancellation of return without order; stock-taking; scrap and pick-up for sale transaction. The main channels out of the inventory were pick-ups for consumption, returns to suppliers and transfers out. Main channels to the inventory were replenishment orders, returns without order and returns from pick-ups. In addition to the physical material transactions, records can be corrected by manual price changes or transfer corrections.

The cumulative value of transaction types in 2011 are presented in the table 5. The main transactions to the inventory included the receipt of purchase order, return without order and return of pick-up. Main out transaction types included pick-ups for consumption, transfer out and returns to supplier.

Table 5. Values of transaction types in 2011

.

In transactions	Value	Out transactions	Value
Receipt of purchase order	*14.28 M€*	Returns to supplier	*0.89 M€*
Return of pick-up	*1.43 M€*	Pick-ups for consumption	*18.2 M€*
Transfer in	*0.90 M€*	Transfer out	*0.90 M€*
Return without order	*6.59 M€*	Cancellation of return without order	*0.09 M€*
Stock-taking, gain	*0.73 M€*	Stock-taking , loss	*0.34 M€*
		Scrap	*0.06 M€*
Return from sale	*0*	Pick-up for sale	*0*
Total	*23.93 M€*	Total	*20.48 M€*

Values of the major transaction types, including RPO, RwO and PU, are presented monthly in Figure 4. The sum value of transactions (SVT) presents the amount of increase or decrease in inventory value when month's in and out transactions are summed.

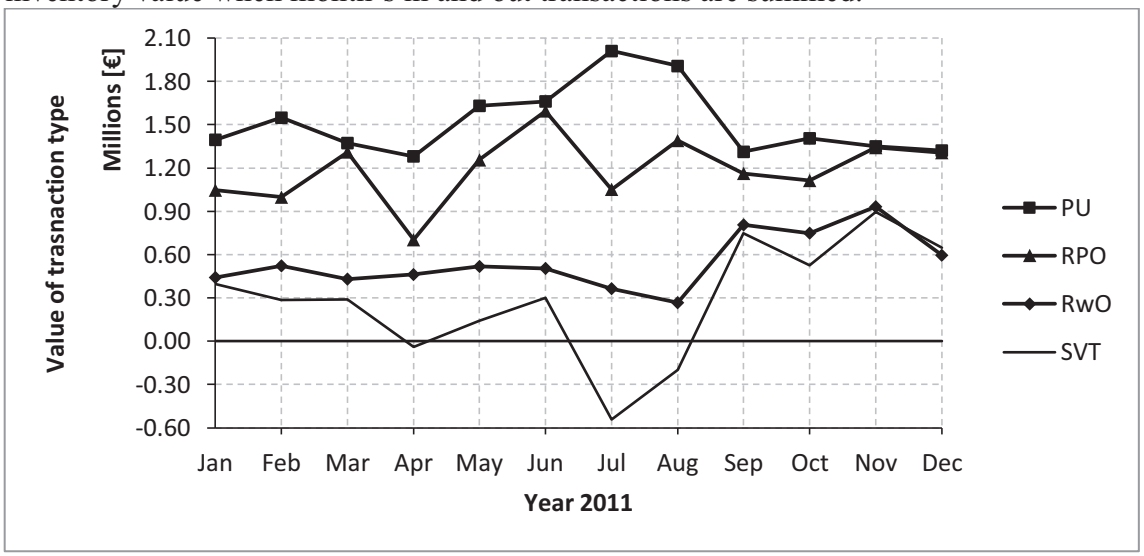


Figure 4. Monthly values of transaction types in 2011.

The SVT has risen to higher level starting from September, which means increasing inventory value. Actually, the SVT remained below zero only for a short period of time. The trend was confirmed directly from the inventory value by analyzing the monthly value during the year 2011. The change to higher level in SVT is caused mainly by increase in returns without order and decrease in pick-ups for consumption, while receipts of purchase orders stay quite flat.

The summer season is typically intensive maintenance period, which obviously affects to the patterns. The unique aspect of the year was the completion of the major investment project in August, which may appears in the results. A systematic event or error, which causes the raised returns without order since August, was not found.

3. Major material flows in and out of the inventory

The most significant transactions or materials flows to the inventory were replenishment orders, returns without order and returns to inventory. Pick-ups for consumption were the main outbound flow. The major material flows are shown cumulated in the figure 5 where inventory is set in between of the suppliers and maintenance, i.e. customers.

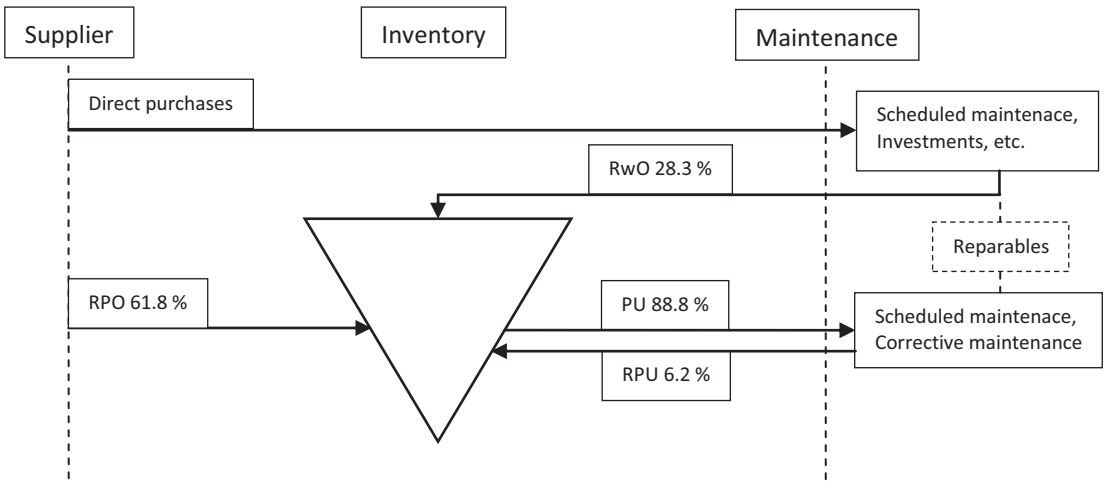


Figure 5. Cumulated material flows into and out of the inventory in 2011.

The conventional replenishment orders (RPO) is not the only significant intake of the inventory. RwO describes the returns without order and RPU describes returns of pick-ups to the inventory. RPO is controlled at item level by control parameters, i.e. order quantity (Q) and reorder point (R), but RwO and RPU cannot be controlled directly by control parameters, because they are caused by incorrectly estimated consumption.

DISCUSSION

In general, the maintenance inventory level in the case company is not fully controlled by the control parameters of the (Q,R)-model, resulting in the unnecessary inventory. The share of overstock depends on reference value used in the estimate. If the reference inventory level is the absolute maximum level enabled by the parameters, the current overstock represents 19.1% of total inventory value. More realistic view of consequences of uncontrollability can be obtained if the current inventory level is compared to the approximated average level, resulting in 36.2% overstock estimate.

The study reveals that there are multiple ways to procure materials using the CMMS, enabling the uncontrolled material flows to the inventory. Thus, the phenomenon of overstocking is permitted. Over a third of the total material flow to the inventory consisted of uncontrolled returns. Increased level of returns and decreased consumption also explain the faster accumulating inventory value starting from September 2011.

In such an environment, the (Q,R)-model is incapable to ensure the material availability in economically sound manner. Especially returns without order (RwO) needs a special attention because it adversely affects to the function of the (Q,R)-model. Because of the RwO, only the lower boundary of the inventory level can be ensured. This means that the service-level can be ensured by the control parameters but, practically, no upper limit to the item's inventory value exists. This also reduces the potential benefits of parameter optimization. Returns of pick-up to the inventory (RPU) can cause a similar effect but with a distinctly smaller magnitude.

1. Theoretical implications

Driessen et al. (2010) describe the structure of the maintenance materials supply chain in the industrial context, but they assume the replenishment orders to be the only way to purchase, which limits at least partially the upper boundary of item's inventory level. For, example, if the material return leads to an unnecessary replenishment, the second replenishment is prevented until the inventory level reaches the reorder-point again. In the case studied in this paper, the materials for some proactive maintenance activities and investments were purchased directly without any link to the inventory control parameters.

This research focuses on the differences between the basic assumptions of the (Q,R)-model and the real context. These basic assumptions are widely hypothesized to take place in the maintenance related literature (e.g. Kennedy et al., 2002). The results of this study show that reality in maintenance material context makes it very challenging to manage the inventory with only two parameters: reorder point and order quantity. It can also be difficult to modify the context to fit to the assumptions of the (Q,R)-model, due to the tendency to maintain the production equipment proactively.

2. Managerial implications

Material managers ought to reduce the share of uncontrolled material flows to the maintenance inventory. One way is to remove the causes of these flows, and another way is to try to predetermine the amount of returns in order to take it into the account in the parameter optimization. The first way includes actions to prevent the materials to flow to the inventory, and the second different kind of forecasting techniques.

An option to remove a cause of the uncontrolled material flow is to develop the procurement policy. If unnecessary materials from scheduled maintenance can be returned to the supplier without expenses, the issue is moved to the upstream in the supply chain. A second option can be the delay time between the request and demand registration as Driessen et al. (2010) proposed.

It may be reasonable to accept a certain amount of returns and instead of total prevent, to try to forecast them as accurately as possible. An obvious action to enable the better forecasting is improving data quality. Currently, the unused product returns and reparables are mixed in the CMMS, and clarification of the data is an overwhelming task. Clearly separating the reparables from other material flows by, for example, creating a new transaction type would enable using the data more precisely. Widely studied newsboy problem (e.g. Mostard and Teunter, 2006), i.e. inventory level determination problem with uncertain demand and perishable products, may also give applicable models for material returns from proactive maintenance activities.

CONCLUSIONS

In this paper, the basic assumptions of the (Q,R)-model turned out to be challenging to fulfill in the maintenance context. As a result, the upper boundary of the items' inventory level, set by the model, does not limit the actual inventory level. On the other hand, nothing indicates that the lower boundary would not be functioning properly. The instant view to the inventory revealed the 25% of the items having higher level than the theoretical maximum enabled by the control parameters. The share of the overstock was 19.1% of the total inventory compared to the theoretical maximum and 36.2 % compared to the theoretical average (Table 3). This means that the model is applicable from service level point of view, but not from the economic one.

The main challenges in the case company in applying the (Q,R)-model in maintenance inventory management, were the uncontrollable returns to the inventory. These returns may contain excess materials from the planned maintenance operations, reparables, and spare parts procured with some investments to the production equipment (Figure 5). The share of these returns was 28.3% of all material flows to the inventory.

In this study, the maintenance materials internal supply chain was analyzed in the case company, which limits the generalization of the results even though the case was selected from capital intensive industry. Also the data and analysis include uncertainties. For example, different kind of errors and mistakes may relate to the individual transactions. In addition to the one identified mechanism, others may exist too, so to be able to confirm the unambiguous causality between the overstocking and uncontrollable material flows, deeper research is required. Another

potential direction for the future research is to identify and analyze the other inventory models than the (Q,R)-model developed to maintenance materials inventory management.

REFERENCES

1. Driessen, M.A., Arts, J.J., van Houtum, G.J., Rustenburg, W.D., and Huisman, B. (2010), "Maintenance spare parts planning and control: A framework for control and agenda for future research", working paper, BETA Research School for Operations Management and Logistics, University of Eindhoven, September.
2. Fleischmann, M., Bloemhof-Ruwaard, J.M., Dekker, R., van der Laan, E., van Nunen, J.A.E.E., and van Wassenhove, L.N. (1997), "Quantitative models for reverse logistics: A review", *European Journal of Operational Research*, Vol. 103, No. 1, pp. 1-17.
3. Garg, A., and Deshmukh, S.,G. (2006), "Maintenance Management: literature review and directions", *Journal of Quality in Maintenance Engineering*, Vol. 12, No. 3, pp. 205-238.
4. Hadley, G., and Whitin, T. (1963), "*Analysis of Inventory Systems*, Prentice-Hall, Eaglewood Cliffs, NJ.
5. Harris, F.W. (1913), "How many parts to make at once", *Factory: The Magazine of Management,* Vol. 10, No. 2, pp. 135–136.
6. Huiskonen, J. (2001), "Maintenance spare parts logistics: special characteristics and strategic choices", *International Journal of Production Economics,* Vol. 71, No. 1–3, pp. 125–133.
7. Kennedy, W.J., Patterson, W., and Fredendall, L.D. (2002), "An overview of recent literature on spare parts inventories", *International Journal of Production Economics,* Vol. 76, No. 2, pp. 201–215.
8. Kothamasu, R., Huang S.H., and VerDuin W.H. (2006), "System health monitoring and prognostics – a review of current paradigms and practices", *International Journal of Advanced Manufacturing Technology,* Vol. 28, No. 9-10, pp. 1012-1024.
9. Mostard, J., and Teunter, R. (2006), "The newsboy problem with resalable returns: A single period model and case study", *European Journal of Operational Research*, Vol. 169, No. 1, pp. 81-96.
10. Muchiri, P., Pintelon, L., Gelders, L., and Martin, H. (2011), "Development of maintenance function performance measurement framework and indicators", *International Journal of Production Economics*, Vol. 131, No. 1, pp. 295-302.
11. Porras, E., and Dekker R. (2007), "An inventory control system for spare parts at a refinery: An empirical comparison of different re-order point methods", *European Journal of Operational Research,* Vol. 184, No. 1, pp. 101–132.
12. Sherbrooke, C.C. (2004), *Optimal Inventory Modeling of Systems: Multi-Echelon Techniques*, Kluwer Academic Publishers, Hingham, USA.
13. Tersine, R.J. (1984), *Principles of Inventory and Materials Management*, 2nd ed., North Holland, NY.
14. Van Horenbeek, A., Buré, J., Cattrysse, D., and Pintelon, L. (2012), "Joint maintenance and inventory optimization systems: A review", *International Journal of Production Economics*, Forthcoming.

15. Wang, W., and Syntetos, A.A. (2011), "Spare parts demand: Linking forecasting to equipment maintenance", *Transportation Research Part E: Logistics and Transportation Review,* Vol. 47, No. 6, pp. 1194–1209.
16. Williams B.D., and Tokar, T. (2008), "A review of inventory management research in major logistics journals: Themens and future directions", *The International Journal of Logistics Management*, Vol. 19, No. 2, pp. 212-232.
17. Yin R.K. (2003), *Case study research: design and methods*, 3rd ed., Sage Publications, Thousand Oaks, CA.

BIOGRAPHICAL

Antti Puurunen is a Doctoral Student at the University of Oulu, Finland. He received his M.Sc. in Engineering from the University of Oulu, in 2012. His research interests cover maintenance materials supply chain management.

Jukka Majava received his M.Sc. in Engineering from the University of Oulu, Finland, in 1999. His industrial experience includes technology marketing, customer care, partner management, project management, and supply chain development at Nokia Corporation. Currently he works as a Doctoral Student in the Department of Industrial Engineering and Management at the University of Oulu.

Hanna Kropsu-Vehkapera (Dr.Sc.) received her MSc in Engineering, majoring in Industrial Engineering and Management, in 2005 and her Dr (Tech) in 2012, both from the University of Oulu, Finland. She currently works as a Post doctoral research fellow at the Department of Industrial Engineering and Management, the University of Oulu, Finland. Her research interests cover information management and product lifecycle management. She has some years of experience from the IT industry.

Pekka Kess (Dr. Sc., Dr. Eng.) is professor of Industrial Engineering and Management at the University of Oulu, Finland. He has extensive managerial experience from both universities and industrial enterprises. He has worked in managerial positions in chemical, steel and electronics industries as well as in software business. He is an active project evaluator and manager in international research and development projects. His research areas are strategic management, production organizations, knowledge management, quality management and e-Learning. He has an extensive network of partners in Europe, Asia and Americas.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

PRIVATE HIGHER EDUCATION IN SLOVENIA

Dušan Lesjak, University of Primorska, Faculty of Management Koper, Slovenia
International School for Social and Business Studies, Celje, Slovenia
dusan.lesjak@fm-kp.si
Vesna Skrbinjek, International School for Social and Business Studies, Celje, Slovenia
Vesna.skrbinjek@mfdps.si

STRUCTURED ABSTRACT

Purpose: *Paper presents differences between private and public higher education (HE) in Slovenia regarding number of students, graduates, academic and non academic staff. It reflects upon growing fragmentation of Slovenian HE and the blurred line between private and public HE institutions (HEIs). Characteristics of Slovenian private HE are described in more detail and can be useful to policy analysts and policy makers as well as researcher-scholars focused on higher education.*
Design/methodology/approach: *Based on the data of the Statistical Office of the Republic of Slovenia (SORS) we first prepared basic overview of HE in Slovenia. Then we examined the relationship between the number of students, graduates, academic staff and non-academic staff in public and private HEIs, and even between publicly and non-publicly funded private HEIs.*
Findings: *We find that growth of private provision has been substantial despite the demographic decline in number of students. Student-to-teacher ratio (Full Time Equivalent – FTE) is better in public than in private HEIs and private institutions offer fewer full-time jobs than public ones. On the other hand private HE has more responsive management, is more flexible and cost-effective. Students –to- non-teaching staff ratio is higher in private than in public HEIs. Publicly funded HEIs account for more than half of enrolled students, graduates and academic staff in private HE. Some similarities can be drawn from public and publicly funded private HEIs on one hand and non-publicly funded private HEIs on the other.*
Limitations/implications: *In conclusion we provide implications for future policy decisions on public-private sector relationship.*
Practical implications: *We provide suggestions to increase interest among students in enrolling in private HE study programmes.*
Originality/value: *We provide a detailed analysis of the private HE in Slovenia with original data that we have collected on individual request.*

Keywords: private HE, public HE, funding, Slovenia
Classification: research paper

INTRODUCTION

In past decades, higher education (HE) has been characterised by an increasing globalisation, market-orientation, privatisation of public and growth of private HE. Private HE has been a result of expanding HE systems, increased and differentiated demand and supply, substantial private returns, increasing constrains on public expenditure, increased levels of cost-sharing, introduction of neo-liberal economic policies and by fostering more internal and external efficient management in HE (Teixteira, 2009; Sanyal and Johnstone, 2011; Varghese, 2013).

However, the concepts of private and public, in the continually changing context of HE are more complex and can be misleading (Marginson, 2007). The difference between public (institutions established by the National Assembly) and private HE is not as obvious as one might think since the first is increasingly adopting characteristics of the latter (e.g. part-time studies with usually employed or older individuals paying tuition fees to study or complete their studies), while private HE is "becoming" public (e.g. public funding of full-time studies at private HE institutions - HEIs). The lines demarcating public and private HEIs have become almost impossibly blurred in many developed and also developing countries (see Sanyal and Johnstone, 2011, 166; Varghese, 2013, 145).

CHARACTERISTICS OF SLOVENIAN HE

In the academic year 2011/2012, there were 89,600 HE students in Slovenia (91,539 in 2010/11), i.e. 70,422 undergraduates and 19,178 postgraduates. One fifth of all students were enrolled in part-time (subject to tuition fees) studies. Women represented 61.1 % of all students.

According to Eurostat, in 2009 Slovenia (where in addition to HE students there were also 14,403 students enrolled in 2-year higher vocational study programmes, adding up to a total of 104,003 students) allocated to tertiary education (TE):

- 1.38% of its GDP , which was above the EU27 average of 1.22% of GDP;
- institutions funds below the EU27 average. Measured in purchasing power standards, Slovenia allocated 7,261.4 EUR per student compared to the EU27 average of 9,243.7 EUR;
- 22.1% of public expenditure for TE for student aid, which was above the EU27 average of 17.4%.

Table 1: Number of public and private HEIs v Slovenia (February 6, 2013)

	Universities (faculties and academies)	**Single HEIs**
Public	3 (49)	1
Private	2 (6)	36

Source: MESCS , 2013.

In Slovenia, there are 4 public and 38 private HEIs (legal entities). In terms of individual faculties and academies, there are 50 public HEIs, i.e. 49 members of 3 public universities and one public single HEI. Among private HEIs, there are 2 universities, i.e. Euro-Mediterranean University - EMUNI which is a network of universities and another university

with 6 faculties, as well as 36 single HEIs reflecting a high level of fragmentation of private HE which is still increasing.

In Slovenian HE, a number of private HEIs have had publicly funded study programmes (programmes with concession) since the beginning of private HE in the mid-90s. Today, there are 12 (33%) single HEIs and one university with concession, meaning a total of 28 study programmes with concession, 20 of which are first-cycle and 8 second-cycle study programmes. Concessions were granted on the basis of a government public call in two periods, in the mid 90s and in 2007/2008 on the basis of two criteria: study areas of shortage occupations (engineering, natural sciences, health care) and regional criterion (located outside the major cities with developed public HE).

Regions in which HE is not developed or present are, irrespective of the small size of Slovenia (20,000 km2), in a very unequal position compared to the regions with university centres. In academic year 2006/07 living expenses of students who did not study in their home town were significantly higher than those of students who lived at home, 634 vs. 292 EUR respectively (Eurostudent SI, 2007, 40).

In Slovenia, social dimension of HE is very important since it can improve access to HE, increase educational structure of the population of the region, and create quality jobs in the region. Furthermore, numerous OECD studies and recommendations show a major influence of HE on the development of human capital, innovation and competitiveness of towns and regions with universities and other HEIs.

These are the key reasons why Slovenia allocates more public funds for student aid than the EU average and why it publicly funds its private HE. In 2010, it allocated 251.4 million EUR to HEIs for study activities (for first- and second-cycle full-time studies), 10.4 million EUR (4.1%) of which went to private HEIs with concession (MHEST, 2010).

CHARACTERISTICS OF SLOVENIAN PRIVATE HE

Private HEIs usualy accounts for a larger number of total HEIs, but for a smaller number of enrolments (Tilak, 2006, 113). This is also true in the case of Slovenia. The number of private HEIs accounts for 45,7 % of total HEIs in terms of individual faculties but the share of students enrolled accounts for 11,7 % (see Figure 1).

Table 3: Students, Graduates and Teachers and assistants in private HE in 2010/11 and 2011/12

	Total	Under. Students / 1st cycle	Post. students/ 2nd +3rd cycle	Total	Under. Students / 1st cycle	Post. students/ 2nd +3rd cycle
Students (2010/11 and 2011/12)	**10,321**	**8,098**	**2,223**	**10,446**	**8,167**	**2,279**
. HEIs with concession	5,652	4,039	1,613	5,521	3,942	1,579
. HEIs without concession	4,669	4,059	610	4,925	4,225	700
Graduates (2010 and 2011)	**1,448**	**1,154**	**294**	**1,500**	**1,124**	**376**
. HEIs with concession	690	516	174	788	579	209
. HEIs without concession	758	638	120	712	545	167
Teachers and assistants* (2010 and 2011)	**1,461**	**420****		**1,556**	**490****	
. HEIs with concession	849	280**		796	319**	
. HEIs without concession	612	140**		760	171**	

* Higher education teachers, assistants and researchers
** FTE (Full Time Equivalent)
Source: SORS, 2012.

Publicly funded private HEIs in 2011/12 account for as many as 52.9% of students (48.3% of undergraduates and 69.3% of postgraduates), 52.5% of graduates and 51% teachers and assistants or 65% (FTE) of private HE.

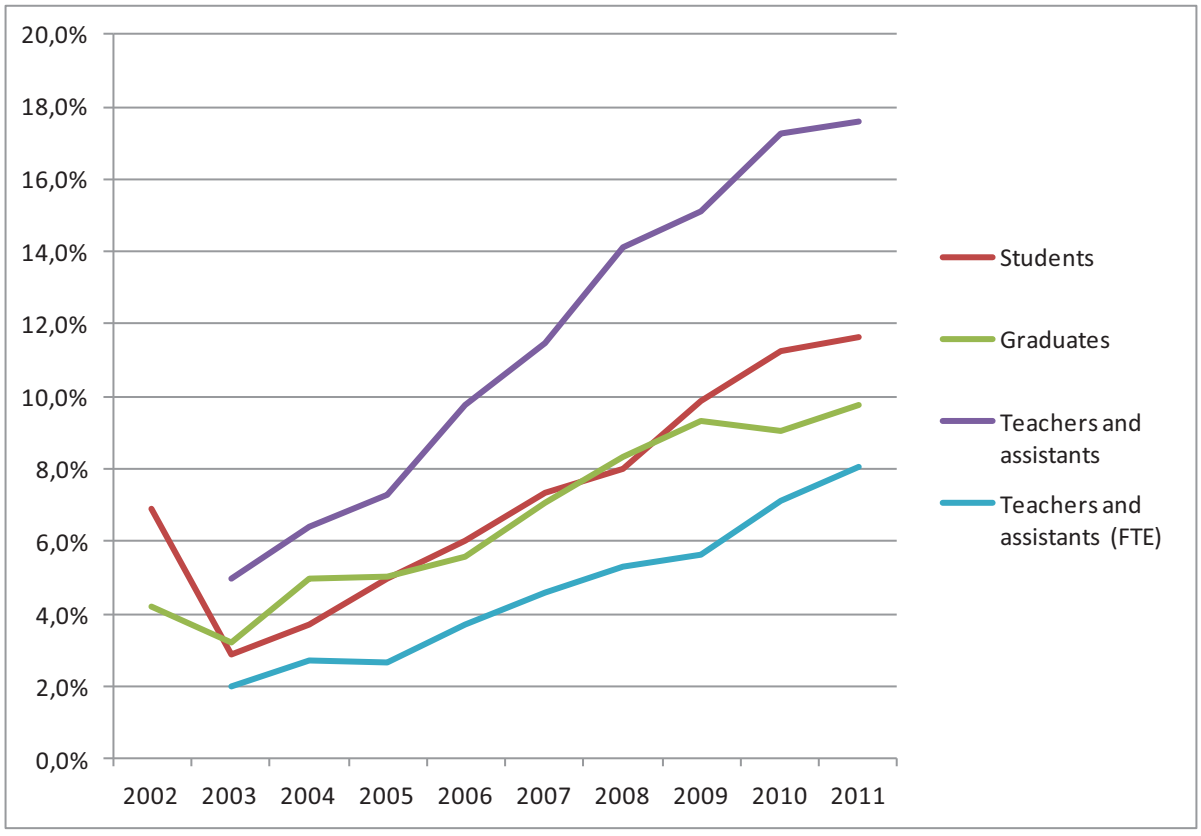


Figure 1: Share of private HE 2002-2011
Source: SORS, 2012.

Since 2003 when single HEIs in Primorska region joined to become the third public university, which is an interesting example of nationalisation of private HE, we have witnessed a sustained growth of private HE despite the decline in the number of students after 2005 when there were over 100,000 students compared to just below 90,000 in 2011.

Private HEIs offer considerably fewer full-time jobs than public HEIs. The main reason for this is that only 33% of them have a concession providing them with a greater stability of funding than tuition fees which depend on annual student enrolment. Another reason is a method of teaching in larger groups which is common in social sciences, business and administrative studies and law, the fields with the most students in private HE.

Table 4: The students to teacher and assistant ratio for 2010/11 and 2011/12

	Students / teacher and assistant		**Students / teacher and assistant (FTE)**	
Academic year	2010/11	2011/12	2010/11	2011/12
HE in total	**10.8**	**10.1**	**15.5**	**14.7**
Public HE	**11.6**	**10.9**	**14.8**	**14.1**
Private HE	**7.1**	**6.7**	**26.9**	**21.3**
. with concession	6.7	6.9	20.2	17.3
. without concession	7.6	6.5	33.4	28.8

Source: SORS, 2012.

The students to teacher and assistant ratio in terms of FTE is significantly better in public (14.1) than private (21.3) HE (2011/12). It is especially unfavourable in HEIs without concession (28.8 in 2011/12 and 33.4 in 2010/11) although a two-year trend indicates improved. This raises a question about the quality of their education and research as much education is carried out by contract teachers and assistants, in addition to which many private HEIs do not carry out research activities.

ADVANTAGES OF PRIVATE HE

One of the key advantages of private HE in Slovenia is that the "interest" of founders of HEIs is much more pronounced and present than in public HEIs. This is reflected in management where individuals in leading positions such as rectors, deans and directors are often not elected but appointed. Management of public HEIs is characterised by a dominant role of teachers who are not qualified for it. Its other feature is an inappropriate composition of management boards in which founders and representatives of employers have much too little influence.

Mainly due to different (better) management, private HE (both foreign and Slovenian) is more flexible and responsive and usually also more cost-effective. This is also reflected in the number of employees in professional/support services.

Table 5: Non-teaching staff ratios for academic year 2011/12

	Non-teaching staff		**Stud. / member of non-teaching staff**		**Non-teaching staff / all staff**		**Teachers and assistants (FTE) / member of non-teaching staff**	
Academic year	2010/11	2011/12	2010/11	2011/12	2010/11	2011/12	2010/11	2011/12
HE in total	**3,726**	**3,845**	**24.6**	**23.3**	**30.5%**	**30.3%**	**1.6**	**1.6**
Public HE	**3,439**	**3,589**	**23.6**	**22.1**	**32.9%**	**33.0%**	**1.6**	**1.6**
Private HE	**287**	**256**	**36**	**40.8**	**16.4%**	**14.1%**	**1.3**	**1.9**
. with concession	161	148	35.1	37.3	15.9%	15.7%	1.7	2.2
. without concession	126	108	37.1	45.6	17.1%	12.4%	1.1	1.6

Source: SORS, 2012.

In public HE there are 22 students per member of non-teaching staff compared to as many as 41 students in private HE for academic year 2011/12 (24 and 36 respectively in 2010/11). This is not only due to less widespread support activities in private HEIs but also to a large duplication of staff at public universities in, for example, accounting, human resource, etc. departments at the level of faculties, academies and rectorates. These results in non-teaching staff representing 33% of all employees in public HE compared to only about 14% in private HE. 1.6 and 2.2 teachers (FTE) per member of non-teaching staff in public HE and private HE with concession respectively is certainly not enough considering that non-teaching staff in Slovenian HEIs generate much less revenue than at foreign universities which as a result have much more diverse revenues and are therefore less dependent on public funds than our HEIs.

VISION OF PRIVATE HE DEVELOPMENT BY 2020

By 2020 the number of 19 year-olds will drop to just over 19,000 compared to over 23,000 in 2010 (in 2000 there were over 29,000 of them and their number will be the lowest in 2019, i.e. 18,776). In this context, the key challenge is how to improve the reputation of private HEIs and thus increase the interest for enrolment in their study programmes.

This can be achieved by:

- strengthening human resource structure which is not integrated in the public sector and therefore has a better wage policy,
- promoting the diversity of study programmes and targeting groups of people not targeted by public HE,
- emphasising the quality of education and introducing online studies,
- enhancing research and international cooperation,
- joining single HEIs into universities which are organised differently than public universities and have a dynamic management with a clear vision and plenty of energy.

INTEGRATION IS THE FUTURE

Private HE contributes to a more dynamic Slovenian HE area, brings much-needed competition and is a balance to the dominance of public HE which has many advantages and privileges in accessing public funds for education and research. Concessions through which a

number of private HEIs are publicly funded have an important positive role not only for the institutions, their employees and students but for the entire HE. This is demonstrated in a greater similarity between public HE and private HE with concession on one hand than between private HE with and without concession on the other.

The state must provide a framework and mechanisms to:

- encourage the development of public and private HE in accordance with EU and national targets,
- encourage the greatest possible quality and accessibility of HE for all those interested,
- supervise HE activities and thus contribute to its greater effectiveness, efficiency and transparency.

Therefore, HE should do its best to follow the OECD recommendation that the future of HE lies in a reliable connection between public and private HE, and that distrust and competition between them should be replaced with mutual trust and cooperation. Only then will HE be able to provide access to quality education and contribute to the development of society (Cheng, 2009, 68).

REFERENCES

1. Cheng, K. (2009), "Public Private Partnership", in Svava Bjarnason, Kai-Ming Cheng, John Fielden, Maria-Jose Lemaitre, Daniel Levy, N.V. Varghese (Ed.), *A New Dynamic: Private Higher Education*, UNECSO, pp. 51-69. Available at http://unesdoc.unesco.org/images/0018/001831/183174e.pdf (accessed 27 February 2013)
2. Eurostat (2012), available at http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/
3. Eurostudent SI (2007), "Economic, Social and Housing Conditions, and the International Mobility of Students in Slovenia", available at http://www.arhiv.mvzt.gov.si/si/delovna_podrocja/visoko_solstvo/statistika_in_analize_s_podrocja_visokega_solstva/ (accessed 4 February 2013)
4. Marginson, S. (2007), "The public/private divide in higher education: A global revision". *Higher Education,* Vol. 2007 no. 53, pp. 307–333.
5. Ministry of Education, Science, Culture and Sports (MESCS) (2013). Register of Higher Education Institutions. Available at http://www.mizks.gov.si/si/delovna_podrocja/direktorat_za_visoko_solstvo_in_znanost/sektor_za_visoko_solstvo/razvid_visokosolskih_zavodov/ (accessed 20 February 2013)
6. Ministry of Higher Education, Science and Technology (MHEST) (2010), Annual financial report for year 2010.
7. Sanyal B.C. and Johnstone, B. (2011), "International trends in the public and private financing of higher education", *Prospects*, vol. 2011 no. 41, pp. 157–175.
8. Statistical Office of the Republic of the Slovenia (SORS) (2012), individual data
9. Teixeira, P. (2009), "Mass Higher Education and Private Institutions". In Higher Education to 2030, vol 2, Globalisation, OECD, pp. 231-258. Available at http://www.acup.cat/sites/default/files/oecd2009highereducation2030volume2globalisation.pdf (accessed 27 February 2013)
10. Tilak, J. B.G. (2006), "Private Higher Education: Philanthropy to Profits". In GUNI, Higher *education in the world 2006: The Financing of Universities*. Palgrave Macmillan,

pp. 113-121. Available at
http://upcommons.upc.edu/revistes/bitstream/2099/6956/1/2006-02_eng_tilak.pdf
(accessed 27 February 2013)

11. Varghese, N.V. (2013), “Private Higher Education”, in India Infrastructure Report 2012. Rutledge, pp. 145-156.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

SHOPPING CART ABANDONMENT : A COMPARISON BETWEEN AMERICAN AND TAIWANESE PERSPECTIVES

Chuleeporn Changchit, College of Business, Texas A&M University – Corpus Christi 6300 Ocean Drive, Corpus Christi, TX 78412, Tel: 361-825-5832, Fax: 361-825-5609, chuleeporn.changchit@tamucc.edu

Tzong-Ru Lee (Jiun-Shen), National Chung Hsing University, Taichung 402, Taiwan, ROC, trlee@dragon.nchu.edu.tw

ABSTRACT

Despite the fact that millions of people use the Internet every day and visit various shopping sites, it is interesting to find that quite a few of them do not complete purchase transactions. It is still a major challenge for online businesses to learn why these e-shoppers chose not to complete the process. This study aimed at comparing the factors that influence the purchase intent and shopping cart abandonment between American and Taiwanese consumers. Three hundred and eighty-six (386) Americans and three hundred twenty-nine (329) Taiwanese participated in this study. The research findings may be used by online businesses to help recognize the factors that influence purchase intentions of these two nationalities. The results should help online businesses gain an understanding of these factors and thus direct their efforts to develop features that satisfy the needs of their target customers.

Keywords: e-Commerce, Shopping Cart Abandonment, Culture, Taiwanese, Americans

INTRODUCTION

According to a survey of U.S. market research by Internet World Stats, the number of Internet users continues to rapidly increase due to the rapid development of the Internet. Until June 2009, the population of global Internet users was more than 1.66 billion people. International Data Corporation (IDC) also estimates that in 2013, global e-commerce trading amount will amount to more than 16 trillion U.S. dollars. As Internet usage increases globally, the e-commerce market also increases, particularly in countries with well-developed marketing infrastructures. Pew Internet, Inc. (2010) reports that 72% of U.S. Internet users made purchases online. Many online shoppers are attracted to the ease and convenience that shopping via the Internet can provide (Shang, Chen, and Shen, 2005).

As the number of Internet user's increases, so does the number of businesses establishing an online presence. Unfortunately for businesses, despite the increased access to customers that the Internet provides, the number of Internet consumers who complete intended purchases without abandoning their cart has not risen. In order to engage with potential online consumers, companies must build a website, attract visitors to the website, and offer products to the customer with the ease of online purchasing in mind. The crucial point in this selling-purchasing process is the final phase — the completion of the purchase. Businesses must be able to close the sale and have a completed purchase before the customer leaves their website. However, their ability to do so can be difficult. Forrester Research (2005) reported that 88% of online shoppers have abandoned their online shopping cart in the past. The phenomenon

of customer shopping cart abandonment prior to purchase completion is a major challenge facing online retailers. Website abandonment rates may vary for different online vendors. However, overall abandonment rates are disturbingly high and indicate that despite the amount of effort and money spent on attracting customers to an online store, companies continue to fail in closing sales.

Prior studies have attempted to find out why shoppers abandon their shopping carts before buying (Changchit, 2006, Kukar-Kinney and Close, 2010; Fenech, 2002; Moore and Mathews, 2008). Although several studies have attempted to investigate shopping cart abandonment, there are two major absences from these prior studies (1) the studies did not focus on the subjects who had an intention to buy and (2) the studies did not take into consideration cultural differences. This study attempts to answer the question: Are there differences between Americans and Taiwanese in terms of reasons for not completing an intended online purchase? In addition, this study also focuses on the subjects who indeed visited a website with an intention to buy instead of just browsing for information.

LITERATURE REVIEW

Online Shopping in the United States

Online purchasing in the United States comprises nearly 40% of global Internet purchases, which is the largest retail online sector in the world (Datamonitor, 2010). Pew Internet and American Life Project (2008) reported that the number of Internet users purchasing products online increased 20% from 2000 to 2007, while e-commerce revenues had grown nearly five times during the same time. In the United States, Internet adoption at home increased from 62.2% in 2002 to 69.6% in 2008 (Talukdar and Gauri, 2011).

A recent study has reported that the number of Internet users in the U.S. has almost doubled over the last eight years to approximately 220 million in 2008 (Hannah and Lybecker, 2010). However, not all consumers are turning to the Internet for shopping. While the number of Internet users who have made an online purchase at one time is more than half, this does not explain the disparity between the number of visits websites record and the number of actual purchases made online. One report shows that although a website may receive millions of visitors, only about 3% of those visits result in a purchase (Betts, 2001). In addition, another study also reported that about 65% of online shopping carts are abandoned before a purchase is completed (O'Neill, 2001).

One explanation of these occurrences is that the majority of consumers are going online to window-shop and plan on making their purchases offline (Forsythe, 2003). Research is seen as a valuable tool by consumers in their decisions to buy products, but the Internet is not seen as the necessary method of purchase. The Internet and its online capabilities are generally seen as a research tool by consumers, as the Internet is capable of disseminating a large amount of information conveniently. Consequentially, although online capabilities include the ability to complete a purchase transaction, a good portion of consumers utilize the Internet to find information about a product and then use the information at a physical shopping location.
Physical locations have the contrasting capabilities of providing sensory perception information for the consumer to use in their purchasing decisions that the Internet is seen as

incapable of satisfying (Shim, et al., 2001). A physical location can provide more in the way of direct social interaction with others and of entertainment through the process of shopping amongst physically present objects for a consumer (Shang, et al., 2005). Despite the benefits the Internet may provide in terms of online shopping, consumers may simply be using the Internet as a research tool, not a purchasing medium, to better inform themselves about products in order to make their purchases offline.

In a study conducted at a university in the South-western United States by Kim and Eastin (2011), the study identified a significant relationship between shopping motivations and exploratory information seeking, impulse buying, as well as a significant relationship between exploratory information seeking and impulse buying. This study also identified significant relationships between pre-purchase online communication and post-purchase online communication, pre-purchase browsing time and pre-purchase online communication as well as, pre-purchase browsing time and online buying frequency. The data showed that perceived credibility of a product by other consumers is positively related to both online buying frequency and pre-purchase online communication.

Using the Theory of Reasoned Action (TRA), Cha (2011) analyzed subjective norms as an antecedent determinant of behavior influencing the online shopping intent of college students. The study asserted that subjective norms have a positive association with purchase intent of both real and virtual items by college students, which was shown as having a significant relationship. This suggests that the more social influence purchasing something online possesses, the more likely they are to complete the purchase. The study also found that the TAM constructs did not influence the intent to purchase virtual items. It also found that security concerns did not influence purchase intent either. Instead, subjective norms and male gender were the significant factors determining the purchase intent of virtual items. Additional research by Chen and Cheng, in their 2009 study of online shopping intentions, confirms the assertions of TRA by making four modifications to the DeLone and McLean model and demonstrating a relationship between satisfaction and behavioral intention and perceived use.

Online Shopping in Taiwan

Lee and Lin (2005) conducted an Internet shopping survey of Taiwanese students. The constructs they tested included the positive correlation between trust, site design, reliability, personalization, and responsiveness to service quality and customer satisfaction by ways of influencing the intent to purchase. The results demonstrated that all the constructs tested affirmed a positive correlation to service quality and customer satisfaction on the intent to purchase except personalization. These findings suggested that in Taiwan, personalization was not a significant factor in the decision to buy. Chin and Kao (2009) conducted online shopping research in Taiwan by measuring the four dimensions of process quality including design, information accuracy, functionality, and ease of use to establish the importance of process quality as a factor that may build customer loyalty. Their research confirmed similar findings with regard to process quality and outcome quality having positive direct influence on customer satisfaction, although behavioral intentions remained unaffected.

Additional research conducted in Taiwan includes the importance of logistics in online shopping and its influence on customer loyalty (Huang, Kuo, and Xu, 2009). This study

determined that the performance of logistical services demonstrated a positive effect on loyalty and indirectly influenced loyalty through customer satisfaction. Liang (2009) studied the critical factors influencing young Taiwanese online shoppers and developed a prediction model based on the results of this study. The prediction model is targeted to Generation Y shoppers for use by the retailers who target this shopping demographic. Risk aversion, convenience, brand reputation, interaction function, promotion, services for members, trust, and site quality all influenced the Generation Y online shoppers' decision to purchase online. These motivational factors should be considered during marketing plan development for online retailers. The motivations to adopt the use of e-payment systems in Taiwan have been investigated by way of comparison to Vietnam (Lin & Nguyen, 2011). They conducted a survey of Taiwanese e-payment users to determine the moderating effects of the Technology Acceptance Model (TAM) and the Personal Innovation in Information Technology (PIIT) construct. The research demonstrated that the TAM model was consistent and that the Taiwanese are more prone to adopt e-payment systems than the Vietnamese. The factors that influenced e-payment adoption in Taiwan were related to culture, affluence, and education level.

Consumer acceptance of the Internet as a distribution channel in Taiwan as studied by Cheng, Sheen, and Lou (2006) revealed that the TAM factors significantly influence positive attitudes towards the Internet as a distribution channel. Perceived security risk showed no influence on consumer attitudes or usefulness perceptions of the Internet as an online distribution channel. They also found that a positive attitude toward online distribution can influence actual use of an online distribution channel.

Cultural Considerations

Culture has long been recognized as an important factor shaping consumer behavior in offline shopping scenarios (Gong, 2009). Hence, one would expect that culture would also shape consumer behavior in an online shopping context. Culture is not an easy concept to define, but there are definitions that have been developed. For example, Matsumoto (1994) states that culture is the degree to which people share attributes, values, beliefs, and behaviors. Perhaps the most popular definition of culture that has been used by many is that of Hofstede who defines culture as "the collective programming of the mind which distinguishes the members of one group from another" (1984, p.21).

In his work, Hofstede (1984) identified four dimensions of culture. The first dimension is power distance, defining as the extent that less powerful members of an organization accept that power is distributed unequally. The second dimension is individualism, which refers to the degree to which individuals emphasize self-interest over that of the group. The third dimension is that of masculinity, which attaches importance to goals such as career and material success versus social goals such as relationships and helping others. The fourth dimension is uncertainty avoidance. This dimension addresses the degree to which people of a society feel uncomfortable with uncertainty and ambiguity.

While Hofstede's work was first applied to human resource management, it is now increasingly used in business and marketing studies (Yoon, 2009). Different cultures respond differently to situations (Fenech and O'Cass 2001; Park and Jun, 2003). This study attempts to examine which factors influence the online shopping perception between these two groups,

Americans and Taiwanese. Data was collected to analyze their overall view of the Internet as a secure vehicle for purchasing goods and/or ordering services. The results should help e-businesses gain an understanding of these factors and thus direct their efforts to tailor the websites to integrate features that satisfy the needs of their target markets.

Shopping Card Abandonment

According to a study of customer behavior in abandoning purchases, it was found that in order for a purchase to be likely, but not completed, there had to be an initial desire for the product and an emotional connection that turned negative and impeded the decision to complete the purchase (Barnes, King and Breen, 2004). In essence, one of the first obstacles that businesses face in physical and online venues is the converting of a viewer to a customer. The intent to buy or purchase a good or service is the initial hurdle. The next obstacle is maintaining the intent of a potential customer to complete a purchase. Chou, Kang and Cheon (2006) found that high perceived uncertainty contributed most to shopping cart abandonment by Anglo college students.

Engendering trust is one aspect of maintaining the intent to purchase by consumers. Trust is seen as a major component of consumer willingness to fully participate in e-commerce by fully completing an online transaction. Several studies have found that trust of the business' online presence was listed as a key element in the decision to make a purchase online (Grabner-Krauter and Kaluscha, 2003). Rajamma, Paswan and Hossain (2009) found that a user's perception of risk is an aspect of online shopping that marketers must overcome to build trust and reduce shopping cart abandonment.

Research by Chau, Hu, Lee and Au (2007) suggests that customers weigh the benefits of providing personal information to an online vendor in terms of the risks of providing such information during the purchase process. The use of privacy seals, availability of refunds, security certificates, and product were important to customer's perceived level of trust.

Gold (2007) also reported a study conducted by the Vividence Corporation, a leader in Customer Experience Management (CEM) products and services. The company evaluated the experiences of 719 consumers as they used shopping carts at e-commerce websites. According to this study, the top ten reasons for shopping cart abandonment are: (1) high shipping prices (72%), (2) comparison shopping or browsing (61%), (3) changed mind (56%), (4) saving items for later purchase (51%), (5) total cost of items is too high (43%), (6) checkout process is too long (41%), (7) checkout requires too much personal information (35%), (8) site required registration before purchase (34%), (9) site is unstable or unreliable (31%), and (10) confusing checkout process (27%).

Another study also examines what factors influence shoppers who have initial intentions of purchasing to change their minds and leave the website without completing a purchase. The results report that the top five factors contributing to the reasons why customers leave websites without purchasing are: (1) I like to see the actual product before buying, (2) I was not sure that the site provides the best price, (3) shipping prices were too high, (4) I did not like to register before checking out the product, and (5) I did not find the desired product (Changchit and Cutshall, 2011).

Although several studies have attempted to investigate shopping cart abandonment, there is an absence of prior studies examining what influence, if any, culture has on shopping cart abandonment. Beyond recognizing the abandonment phenomenon exists, it is important to understand what role culture plays in making shoppers abandon their online shopping cart. This study, therefore, aims at examining the cultural differences between Americans and Taiwanese in terms of what factors influence shoppers who have initial intentions of purchasing online, but ultimately change their minds, abandon their online shopping carts, and leave the website without completing a purchase.

RESEARCH METHODOLOGY

A direct survey was used to collect the data for this study. The survey questions are compiled from previous study questions pertaining to consumer behaviors (Alomaim, et al., 2003; Joines, Scherer and Scheufele, 2003; Kohli, Devaraj and Mahmood, 2004; Koivumaki, 2001; Koyuncu and Lien, 2003; Lin, 2003; Posnock, 2004). The survey consists of fifty-eight (58) questions. Twenty (20) questions were asked to gather information on subjects' perception about online shopping. Twenty-two (22) questions were designed to examine why subjects leave the website before completing the transaction. For these 22 questions, the survey asked subjects to refer to the most recent website they visited with an intention to buy, but decided to leave without actually buying. Two (2) two questions ask for expected benefits subjects have for online shopping. One (1) question asks whether subjects prefer online shopping or physical store shopping. The remaining thirteen (13) questions ask for subjects' demographics.

The survey was developed with five-point Likert scaled questions. Answers to the scaled questions ranged from "strongly disagree" to "strongly agree" as end points. Subjects were asked to rate their level of agreement with each item as a reason that may have caused them to leave a website without buying. To validate the clarity of these questions, three professors and three researchers were asked to read through the survey questions. Revisions to the survey were made based on the feedback received.

For the American subjects, the surveys were administered to random shoppers at local malls and to students at a South-western United States university. Three hundred and eighty-six (386) subjects completed and returned the survey instruments. However, forty-two (42) subjects do not have an experience conducting an online transaction. They are thus excluded from the data analysis. Details on the subjects' demographics are provided in Table 1 below.

Table 1: Subjects' Demographics (Americans)

Gender					
Male: 178 (51.74%)		Female: 166 (48.26%)		No Answer: 0 (0.0%)	
Age (in years)					
Under 18: 1 (0.29%)	18-24: 274 (79.65%)	25-34: 45 (13.08%)	34-44: 14 (4.07%)	45 up: 10 (2.91%)	No Answer: 0 (0.0%)
Highest Education					
Less than High School: 4 (1.16%)	High School: 271 (78.78%)	Bachelor: 60 (17.44%)	Graduate: 6 (1.74%)	No answer: 3(0.87%)	
Employment Status					
Yes: 259 (75.29%)		No: 83 (24.13%)		No answer: 2(0.58%)	
Income					
Less than $20,000 249 (72.38%)	$20,000- 40,000 57 (16.57%)	$40,000-60,000: 15(4.36%)	Greater than $60,000: 17(4.94%)	No Answer: 6(1.74%)	
Own Credit/Debit Card					
Yes: 329(95.64%)		No: 11(3.20%)		No Answer: 4 (1.16%)	
Credit Card Type Most Frequently Used					
Visa: 224 (65.12%)	MasterCard: 85(24.71%)	American Express: 15(4.36%)	Discover: 8 (2.33%)	Others: 12(3.49%)	
Have Internet Access at Home					
Yes: 326 (94.77%)		No: 18 (5.23%)		No Answer: 0 (0.0%)	
Have Returned Product Purchased Online Before					
Yes: 128 (37.21%)		No: 212 (61.63%)		No answer: 4(1.16%)	
Number of Times Browsing a Website But Not Purchase					
None: 24 (6.98%)	1-5 105 (30.52%)	6-10 93 (27.03%)	11 and up 119 (34.59%)	No Answer 3(0.87%)	

For the Taiwanese subjects, the surveys were administered to Taiwanese consumers. Three hundred and twenty-nine (329) subjects completed and returned the survey instruments. However, only two hundred and fifty-four (254) subjects were shopping online and were included in the data analysis. Details on their demographics are provided in Table 2 below.

Table 2: Subjects' Demographics (Taiwanese)

Gender					
Male: 92 (36.22%)		Female: 160 (62.99%)		No Answer: 2 (0.79%)	
Age (in years)					
Under 18: 0 (0%)	18-24: 145 (57.09%)	25-34: 85 (33.46%)	34-44: 19 (7.48%)	45 up: 4 (1.57%)	No Answer: 1 (0.39%)
Highest Education					
Less than High School: 3 (1.18%)	High School: 7 (2.76%)	Bachelors: 191 (75.20%)	Master's & up: 52 (20.47%)	No answer: 1(0.39%)	
Employment Status					
Yes: 156 (61.42%)		No: 96 (37.80%)		No answer: 2 (0.79%)	
Income					
Less than $20,000: 34 (13.39%)	$20,000-40,000: 88 (34.65%)	$40,000-60,000: 31(12.2%)	Greater than $60,000: 15(5.91%)	No answer: 86 (33.86%)	
Own Credit/Debit Card					
Yes: 122 (48.03%)		No: 129 (50.79%)		No Answer: 3 (1.18%)	
Credit Card Type Most Frequently Used					
Visa: 86 (33.86%)	MasterCard: 21 (8.27%)	American Express: 0 (0.0%)	Discover: 0 (0.0%)	Other/No Credit Card: 147(57.87%)	
Have Internet Access at Home					
Yes: 253 (99.61%)		No: 1 (0.39%)		No Answer: 0 (0.0%)	
Have Returned Product Purchased Online Before					
Yes: 85 (33.46%)		No: 166 (65.35%)		No answer: 3(1.18%)	
Number of Times Browsing a Website But Not Purchase					
None: 5 (1.97%)	1-5 98 (38.58%)	6-10 64 (25.2%)	11 and up 85 (33.46%)	No Answer 2(0.79%)	

DATA ANALYSIS AND DISCUSSION

This study aims at identifying the cultural differences between online shopping perceptions of American and Taiwanese subjects. Subjects were divided into two groups, American (344) and Taiwanese (254). Statistical t-tests on the means were conducted on subjects' responses to the question "Overall, I prefer to shop online than in the physical store". The compared results are presented in the Table 3 below:

Table 3: T-Test - Two-Sample Assuming Unequal Variances

Overall, I prefer to shop online than in the physical store	American	Taiwanese
Mean	3.680758017	3.236220472
Variance	1.050564336	0.845165105
Observations	343	254
Hypothesized Mean Difference	0	
df	574	
t Stat	5.560938774	
P(T<=t) one-tail	2.05835E-08	
t Critical one-tail	1.647512593	
P(T<=t) two-tail	4.11671E-08*	
t Critical two-tail	1.964105441	

* indicates p-value <= 0.05

The results of the t-test show a significant difference between the American and Taiwanese preferences for online shopping. On the average, American subjects prefer online shopping more than Taiwanese subjects.

Additional statistical t-tests were conducted on subjects' responses to 20 questions testing perception factors of online shopping. The results are in Table 4. These results mostly support why more Americans prefer online shopping than Taiwanese. Except the perceived ease of use, the remaining four factors were perceived differently between Americans and Taiwanese. On the average, Americans perceive higher positive experiences, better security, and lower uncertainty with online shopping than Taiwanese.

It is also interesting to note that on the average, Taiwanese perceive higher benefits of online shopping than Americans. However, according to the result shown in Table 3, more Americans prefer online shopping than Taiwanese. This finding may indicate that of all the five factors, the perceived benefits of online shopping may be the least important compared to other concerns such as security or uncertainty.

Table 4: Consumers' Perceptions with Online Shopping

Factors	Mean: Americans	Mean: Taiwanese	p-value
Perceived Benefits of Online Shopping	3.27	3.42	0.0026*
Perceived Ease of Use of Online Shopping	3.72	3.66	0.2312
Past Experience with Online Shopping	3.85	3.36	0.0000*
Perceived Security of Online Shopping	2.97	2.75	0.0007*
Perceived Uncertainty of Online Shopping	3.14	3.78	0.0000*

* indicates p-value <= 0.05

Additional data were also collected from subjects to examine the reasons why they did not complete the purchase transactions although they have visited the websites with an intention to buy. The results are demonstrated in Table 5 below.

Table 5: Reasons for not Completing Purchase Transactions

Reasons	Average	
	American	Taiwanese
I did not have enough time to complete the purchase.	2.45	2.80
I did not find the desired product	**3.22**	3.18
I did not find the information about shipping	2.54	2.57
I was not sure that the site provides the best price	**3.40**	3.37
The pages took too long to download	2.66	2.70
The site was confusing	2.68	2.85
Shipping prices were too high	**3.33**	**3.59**
Taxes were too high/ not expect to pay tax	2.63	2.93
I hesitated to provide credit card information	3.03	**3.52**
The checkout processes requires too much information	3.04	**3.61**
I did not like to register before checking out the product	**3.38**	**3.60**
The site did not accept credit cards	2.24	2.87
The site did not accept checks	2.38	2.45
Total cost of items were too high	3.02	3.49
I would like to contact customer service for more information	2.70	3.42
I was afraid of receiving wrong product	2.70	2.82
I was afraid that product might not arrive on time	2.95	3.31
I like to see the actual product before buying	**3.45**	**3.87**
I did not like the design of the website	2.54	2.74
My credit card was reject	1.88	2.37

The top five reasons why American did not complete the purchase transaction are as follows:
1. I like to see the actual product before buying (3.45)
2. I was not sure that the site provides the best price (3.40)
3. I did not like to register before checking out the product (3.38)
4. Shipping prices were too high (3.33)
5. I did not find the desired product (3.22)

The top five reasons why Taiwanese did not complete the purchase transaction are as follows:
1. I like to see the actual product before buying (3.87)
2. The checkout processes requires too much information (3.61)
3. I did not like to register before checking out the product (3.60)
4. Shipping prices were too high (3.59)
5. I hesitated to provide credit card information (3.52)

Comparing the reasons for shopping cart abandonment between these two nationalities, it is very interesting to note that both Americans and Taiwanese share the same three reasons and they are even ranked at the same orders. It is very obvious that the main concerns for them are the lack of the ability to see the actual product as both nationalities rank this concern as

the top reason why they decided to abandon the shopping cart. The other two main concerns that they share are the requirement for registration and shipping prices.

The other two concerns among the top five that Americans have are the uncertainty that they will find the best price online and the inability to find the product they like. Although these two factors were not ranked among the top five for Taiwanese, they seem to be of concern to the Taiwanese as well, ranking high at 3.37 and 3.18, respectively.

The remaining two concerns among the top five that Taiwanese have are the hesitation to provide credit card information and the amount of information required for the check-out process.

In addition to gathering data on the reasons why subjects did not complete the purchase transaction, two questions were also asked to examine what can encourage them to place a transaction in terms of better prices and shipping times. Table 6 below shows the expected discount and the length of lead time subjects expected when shopping online.

Table 6: Expected Discount and Lead Time from Online Shopping

Americans	Taiwanese
On the average, the product is 25.12% cheaper than a physical store	On the average, the product is 57.97% cheaper than a physical store
On the average, the shipping time is no longer than 6.52 days	On the average, the shipping time is no longer than 3.64 days

The results suggest that, on the average Taiwanese expect much higher benefits from online shopping than Americans. This finding also conforms to the findings in Table 1 that more Americans prefer Internet shopping than Taiwanese.

CONCLUSION

This study compares online shopping perceptions between Americans and Taiwanese. The results of the study reveal the factors that cause the shoppers who have initial intentions of purchasing to change their minds and leave the website without completing a purchase.

The findings suggest that American prefer online shopping more than Taiwanese. Further analysis also reveals that this may be due to the fact that Taiwanese perceive less security and higher uncertainty when shopping online.

Additional data from the survey from both populations revealed the top five reasons customers leave websites without purchasing and it is noteworthy that they share the same three reasons: (1) I like to see the actual product before buying, (2) I did not like to register before checking out the product, and (3) shipping prices were too high.

Two concerns of the top five for American subjects that are not among the top five for Taiwanese subjects are (1) the uncertainty that they find the best price and (2) the inability to find the product they like. This result suggests that in order to encourage more American to

buy online, the online businesses may want to include the price comparison feature or price-match policy to give potential customers peace of mind that they are getting the best price. In addition, a feature to gather feedback from the customers about the product they cannot find from the website should be incorporated.

The two concerns of the top five from Taiwanese subjects that are not among the top five from American subjects are (1) the hesitation to provide credit card information and (2) the amount of information required for the check-out process. These results suggest that Taiwanese subjects do not trust the security of the website and highlights the need for online businesses to better design the check-out process. In order to encourage the Taiwanese to buy online, online businesses may need to come up with a fraud protection policy and consider collecting only necessary information via the check-out process. Taiwanese respondents also expect a much better price and shorter delivery time than Americans. These findings suggests that marketers and online businesses in Taiwan may have to offer more in the way of price reductions, delivery options, and security to truly capitalize on the online market potential presented by the Taiwanese population.

This study contributes to current literature by exposing how cultural dimensions influence online purchase intentions of Americans and Taiwanese. More research is needed with respect to cultural differences in online shopping intentions. Research concerning other populations beyond these two would continue to contribute to the growing research area of online retailing and facilitate growth of the online marketplace in terms of creating viable business offerings to a diverse Internet population.

REFERENCES

1. Barnes, J., King, B., & Breen, G. (2004). "The almost customer: a missed opportunity to enhance corporate success," *Managing Service Quality*, 14 (2/3), 134 -146
2. Betts, M. (2001), "Turning browsers into buyers," *MIT Sloan Management Review,* 42(2), 8-9. 2001.
3. Cha, J. (2011). "Exploring the internet as a unique shopping channel to sell both real and virtual items: a comparison of factors affecting purchase intention and consumer characteristics," *Journal of Electronic Commerce Research*, 12(2), 115-132.
4. Changchit, C. (2006). "Consumer perceptions of online shopping," *Issues in Information Systems*, 7(2), 177-181.
5. Changchit, C. & Cutshall, R. (2011). "Vanishing revenues: an exploratory look at why online consumers do not complete intended online purchases," *Journal of International Business Management & Research,* 2(3).
6. Chau, P., Hu, P., Lee, B., & Au, A. (2007). "Examining customers' trust in online vendors and their dropout decisions: An empirical study" *Electronic Commerce Research and Applications,* 6, 171-182.
7. Chen, C. & Cheng, C. (2009). "Understanding consumer intention in online shopping: a respecification and validation of the DeLone and McLean model," *Behaviour & Information Technology*, 28(4), 335-345.
8. Cheng, J., Sheen, G., & Lou, G. (2006). "Consumer acceptance of the internet as a channel of distribution in Taiwan – a channel function perspective," *Technovation*, 26, 856 – 864

9. Chin, C. & Kao, Y. (2009). "Relationships between process quality, outcome quality, satisfaction, and behavioral intentions for online travel agencies – evidence from Taiwan," *The Service Industries Journal*, 30, 2081- 2092.
10. *Cho, C., Kang, J. & Cheon, H. (2006) "Online Shopping Hesitation," C*yberPsychology and Behavior,* 9(3), 261-274.
11. Datamonitor (May 2010). Online Retail in the United States. (Publication No. 0072-2344). New York, NY.
12. Fenech, T. (2002). "Antecedents to web cart abandonment", In Shaw, R. N.; Adam, S.; and McDonald, H., eds., *Proceedings of the Australian and New Zealand Marketing Academy Conference,* Melbourne: Interactive Marketing, 3351-3357.
13. Fenech, T. & O'Cass, A. (2001). "Internet users' adoption of Web retailing: user and product dimensions," *Journal of Product & Brand Management*, 10(6), 361 - 381
14. Forrester Research (2005). *Rethinking the Significance of Cart Abandonment*. Carrie A. Johnson, Charles p. Wilson, Sean Meyer, (ed).
15. Forsythe, S. & Shi, B. (2003). "Consumer patronage and risk perceptions in Internet shopping", *Journal of Business Research,* 56(11), 867-875.
16. Gold, K. (2007). Tackling the shopping cart abandonment rate. http://www.searchmarketing standards. com
17. Grabner-Krauter, S. & Kaluscha, E. (2003). "Empirical research in on-line trust: a review and critical assessment," *International Journal of Human Computer Studies*, 58(6), 783-812.
18. Huang, Y., Kuo, Y., & Xu, S. (2009). "Applying Importance-Performance Analysis to Evaluate Logistics Service Quality for Online Shopping Among Retailing Delivery," *International Journal of Electronic Business Management*, 7(2), 128-136.
19. Hannah, B. & Lybecker, K., (2010). "Determinants of recent online purchasing and the percentage of income spent online", *International Business Research,* 3(4), 60-71.
20. Hofstede, G. (1984). *Culture's Consequences: International Differences in Work-Related Values*. Beverly Hills, CA: Sage Publications.
21. Internet World Stats, (2012). Internet Broadband Subscribers in USA, Subscriber Statistics. http://www.internetworldstats.com/am/us.htm (Retrieved February 13, 2012).
22. Kim, S., & Eastin, M. (2011). "Hedonic tendencies and the online consumer: An investigation of the online shopping process," *Journal of Internet Commerce*, 10(1), 68-90.
23. Kukar-Kinney, M. & Close, A. (2010). "The determinants of consumers' online shopping cart abandonment," *Journal of the Academy of Marketing Science*, 38, 240-250.
24. Lee, G. & Lin, H. (2005) "Customer perceptions of e-service quality in online shopping," *International Journal of Retail & Distribution Management*, (33) 2, 161-176.
25. Liang, D. (2009). "Critical Factors Influencing Taiwanese Young Adults' Willingness to Shop Online," *Web Journal of Chinese Management Review*, (12) 4, 1-23.
26. Lim, N. (2003). "Consumer's perceived risk: sources versus consequences," *Electronic Commerce Research & Applications, 2*(3), 216-228.
27. Lin, C. & Nguyen, C. (2011). "Exploring E-Payment Adoption in Vietnam and Taiwan," *Journal of Computer Information Systems*, 51(4), 41-52.

28. Matsumoto, D. (1994). *Psychology From A Cultural Perspective*. CA: Brookes/Cole.
29. Moore, S. & Mathews, S. (2008). "An exploration of online shopping cart abandonment syndrome – a matter of risk and reputation," *Journal of Website Promotion*, 2(1), 71-88.

30. O'Neill, B. (2001). "Online shopping: Consumer Protection and Regulation," *Consumer Interests Annual,* 47, 1-3.
31. Park, C., & Jun, J. K. (2003). "A cross-cultural comparison of internet buying behavior: Effects of internet usage, perceived risks, and innovativeness," *International Marketing Review*, 20(5), 265-335.
32. Pew Internet, Inc. (2010). Internet Activities. Available at: http://www.pewinternet .org/Static-Pages/Trend-Data/Online-Activites-Total.aspx (accessed 29 January 2011).
33. Pew Internet & American Life Project. (February, 2008). Online Shopping. Washington, D.C.
34. Rajamma, R., Paswan, A., & Hossain, M. (2009). "Why do shoppers abandon shopping cart? Perceived waiting time, risk, and transaction inconvenience. *Journal of Product & Brand Management, 18*(3), 188 – 197
35. Shang, R., Chen, Y., & Shen, L. (2005). "Extrinsic versus intrinsic motivations for consumers to shop on-line," *Information & Management*, 42(3), 401-413.
36. Shim, S., Eastlick, M. , Lotz, S., & Warrington, P. (2001). "An online prepurchase intentions model: The role of intention to search," *Journal of Retailing,* 77(3), 397-216.
37. Talukdar, D. & Gauri, D. (2011). "Home Internet Access and Usage in the USA: Trends in the Soci-Economic Digital Divide," *Communications of the Association for Information Systems*, 28 (7), 85-98.
38. Yoon, C. (2009). "The effects of national culture values on consumer acceptance of e-commerce: online shoppers in China," *Information & Management*, 46, 294-301.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE IMPACT OF ONLINE BANKING ON CUSTOMER SERVICE DELIVERY IN THE MALAYSIAN BANKING INDUSTRY : KANO'S MODEL APPRAOCH

Tasmin, R, Department of Technology Management, Faculty of Technology Management and Business, University Tun Hussein Onn Malaysia, 86400, Parit Raja, Batu Pahat, Darul Ta'zim, Johor, Malaysia

Alhaji Abubakar Aliyu, Department of Technology Management, Faculty of Technology Management and Business, University Tun Hussein Onn Malaysia, 86400, Parit Raja, Batu Pahat, Darul Ta'zim, Johor, Malaysia, dogoalhaji@yahoo.com

Norazlin, H., Department of Technology Management, Faculty of Technology Management and Business, University Tun Hussein Onn Malaysia, 86400, Parit Raja, Batu Pahat, Darul Ta'zim, Johor, Malaysia

Josu Takala, Department of Production, University of Vassa, City of Vassa, Finland

ABSTRACT

This study is about the impact of online banking on customer service delivery in Malaysian banking industry. Due to the challenges of globalization and intensive competition, Banks were compelled to comprehend the services of online banking in order to entice the existing and the potential customers. Although, the level of awareness is relatively high; but still only 64% patronize online banking in Malaysia. It is against this background that this paper seeks to examine the significant factors that may cause online banking to have an impact on customer service delivery with the ultimate aim of either accepting or rejecting any preconceived idea of the researcher. The study employed some hypotheses in order to guide the research in achieving the overall aim of the research as well as testing the stated hypotheses. Behavioral factors such as security, convenience and cost were the main concern of the respondents towards effective service delivery. The study reveals that "Cost" is the major driver of effective service delivery of online banking services in Malaysia. Equally, the study also explores various implications of the research.

Keyword: Behavioral factors, customer service delivery, Kano's Model, Malaysian banking industry, online banking.

INTRODUCTION

A strong online banking services are an important driver in the banking industry for Bank's performance and customer service delivery. It can have a significant effect in supporting economic development through efficient financial services. Aliyu and Tasmin (2012a). As the banking industry becomes global in nature, faces a competitive environment; banks are forced to balance the goals of outreach and sustainability. Thus, online banking may be the instigator of this new environment and the prime mover in terms of providing the potential solution for bank's survival in the near future (Anyasi, et al 2009; Musiime, 2010; Hazlina, et

al 2011a and Hazlina, et al 2011b). Research has proven that, electronic banking services (EBS) are the wave of the future banking by providing enormous benefits to consumers in terms of ease and cost of transactions through online banking (Nsouli, et al, 2002).

Due to little research conducted in Malaysia in the areas regarding accessing the external factors that entice or discourage customers to patronize online banking, there is a strong need for this study to address two major issues,

- The first one is to conduct an empirical study so as to assess the significant factors that may cause online banking to have an impact on customer service delivery in Malaysian commercial banks.
- Secondly, there is a need to examine the relationship between the factors that may affect online banking and online banking services in Malaysian commercial banks.

By understanding the basic factors that encourage customers to patronize online banking, this will go a long way in reaping the benefits of online banking and also for banks to remain competitive and profitable in the long run.

FACTORS INHIBITING ONLINE BANKING ADOPTION

Behavioral (external) factors are the important determinants of online banking adoption as disclosed by Rahmath, *et al.,* 2011. Behavioral factors pertaining to convenience, security, cost, prior experience and volume of transaction where the focus of this study as they have a reciprocal influence on customer service delivery (Suganthi, 2010; Ombati, 2010 and Ahmad, 2011).

- Cost: - is one of the major factors that influence consumers' adoption of innovation. Aliyu & Tasmin (2012a), stated that for consumers to use new technologies, the technologies must be reasonably priced relative to alternatives. Otherwise, the acceptance of the new technology may not be viable from the standpoint of the customer.

- Security is another very important factor in determining the decision of customers to use online banking. Aliyu & Tasmin (2012b), identify “security” as an important characteristic from a customer's perspective on the adoption of innovation.

- While, convenience is considered to be an influential factor for the use of online banking. Still, there is a positive relationship between convenience and service delivery vie online banking, such as the ability of online banking to meet users' needs using the different feature availability of the services. (Malarvizhi, 2011)

Previous researches reveal that customers are more sensitive to the behavioral factors mentioned above in terms of customer service delivery vie online banking than the internal factors. This means that there is a direct relationship between technology and behavioral (external) factors in the adoption of online banking. Therefore, the level of online banking adoption will directly impact on the degree to which the customers are satisfied, in terms of the behavioral factors (Musiime, 2010). This reveals that effective service delivery on behavioral factors may result to customer loyalty (which impacts their future utilization of online banking patterns) in relation to other factors just like it has on customer satisfaction.

Thus, banks should give high priority to behavioral factors and should consider it as important key drivers towards successful implementation of online banking (Khong, et al., 2006; Nek, et al 2009; Shirshendu and Sanjitkumar, 2011)

CUSTOMER SERVICE DELIVER IN THE BANKING INDUSTRY

According to Parasuraman et al., (1985), the study of customer service delivery has gained interest just after the concern on improving the quality of products and services become increasingly important in the globe. Today, information and communication technology, competition, deregulation and globalization have changed the landscape of the banking industry in such a way that it is characterized based on the services the banks offer to customers across the globe. This is one of the major reasons why the banking industry is among the most intense in deploying high technology innovation. (Drucker, 1985a; Drucker, 1999b and Shoebridge, 2005). It is noticeable that online banking, enabled banks to service customers not only in branches and other dedicated services sites, but also in a myriad of other channels (Lovelock, 1996 and Al-Hawari, et al., 2005).

Thus, delivering effective customer service is indeed an important marketing strategy (Berry and Parasuraman, 1995), but the difficulty in defining customer service delivery in deploying a specific contextual instrument for measuring such constructs represents important constraints for the banks to approach their markets.

A CONCEPTUAL MODEL AND HYPOTHESES

For the purpose of understanding the factors influencing online banking services towards customer service delivery, this paper proposes a conceptual model (see figure 1). This conceptual model is developed based on several previous studies related to electronic banking, behavioral factors, banking application, and customer service delivery.

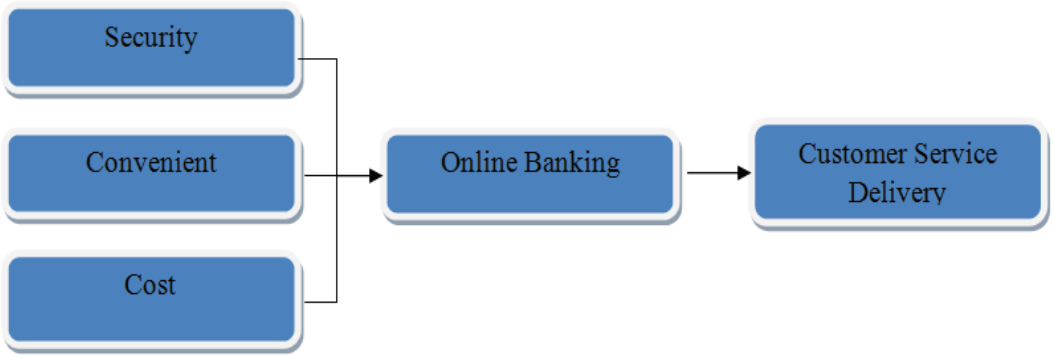


Figure: 1 Conceptual Research Model (Source: Literature Survey, 2012)

The following hypotheses are developed based on the conceptual model and literature review discussed:

- Ho1 There is a significant relationship between cost and online banking in Malaysian banking industry.
- Ho2 There is a significant relationship between convenience and online banking in Malaysian banking industry.
- Ho3 There is a significant relationship between security and online banking in Malaysian banking industry.
- Ho4 There is a significant relationship between online banking and customer service delivery in Malaysian banking industry.
- Ho5 There is a significant relationship between customer service delivery and customer's satisfaction in Malaysia banking industry.

RESEARCH MODEL

The research framework of this study is based on the adaptation of Kano's Model first developed by Professor Kano in 1984. The Kano's model of customer satisfaction seeks to explain how assigning priorities to operational objectives may result in lasting improvements in customer service delivery. Essentially, the Kano's model is used for the classification of product and services based on understanding wishes and the way it affects customer's satisfaction. Kano (1984) suggests a model that helps researchers distinguish between three types of product/service requirements which influence customer satisfaction in different ways when met. Thus, the Kano's model is viewed in the perspective of online banking service on customer service delivery. In fact, Kano's diagram (seen figure 2) shows customers' satisfaction in relation to the product/service level and the quality of service delivery.

In addition, Professor Kano believes that for effective customer service delivery, banks should make sure that the level of service delivery such as security, convenience and cost should meet all of the customers' requirements and not only what the customer states (Bhattacharyya and Rahman, 2004). The essence of choosing the Kano's model in this study is because, the model could provide a unique opportunity for understanding the impact of online banking on customer service delivery and identify the categories of behavioral factors to be managed. Secondly is to support the Malaysian banks in strategizing their decision toward enhancing effective and efficient customer service delivery. Hence, this model shows the best way for putting the fundamental principles of good behavioral factors in place and continually expanding and enriching that set of principles which makes it easy to apply in different situations.

In addition, research has proven that, one of the economic methods to achieve effective customer service delivery in the service industry is through Kano's model which has been registered (Ardhiyani, 2012). The study considers online banking as the major tool of interaction with customers, while behavioral factors such as security, convenience and cost are classified as banking capabilities at the root of effective customer service delivery.

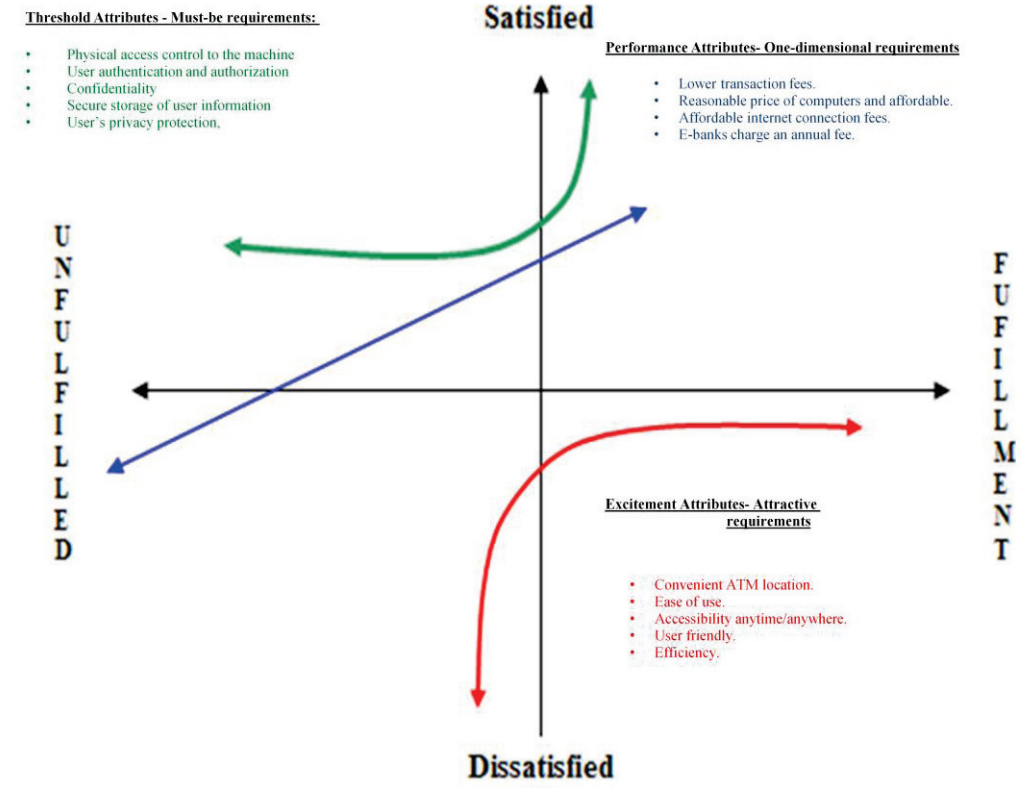


Figure 2: Kano's Model Customer Satisfaction, with Some Modifications (Kano et al, 1984)

METHODOLOGY

The research data was collected through questionnaires base on the various research conducted, in which the questionnaires were modified so that it suite the research's intention towards examining some behavioral factors that influence the service of online banking in Malaysia. The questionnaires contain 40 questions that measure 3 independent variables, one intervening variable and one dependent variable. The research use 8 questions to measure the respondent profile and 6 questions each to answer the customer's perception of security, cost and convenient.

Table 1 Description of questionnaire used

Item	Variable	Sample Question	Source
6	Security	I feel Banks should focus on important aspects of security and privacy of Online banking	Fleming, N. (2011), Abdullah et al.. (2011), Suganthi, (2010) and Poon and Tan (2008)
6	Cost/Price	I feel my bank cost/charges is expensive compared to other banks.	Suganthi, (2010), Poon and Tan (2008) and Felix et al (2011); Felix et al (2011)
6	Convenient	I feel the convenience of Online Banking has an influence on customer satisfaction.	ThotH Thomas et al..(2010),Suganthi,(2010), Poon and Tan (2008)
6	Online banking	I feel there is a need for further enhancement on Online Banking to satisfy customers.	Abdullah et Al..(2011); Ms. Malarvizhi.V (2011), Hazlina et al (2011), Goi, C. L. (2006), Felix et al (2011)
8	Customer service delivery	I feel, the key to success for online Banking lies in knowing customers current and future needs	Musiime, (2010), Hazlina et al (2011)

Source: Field Survey (2012)

The research uses the 5 point Likert-scale to collect the data, ranging from 1= Strongly Disagree, 2 = Disagree, 3 = Moderate, 4 = Agree and 5 = Strongly Agree. Moreover, additional questions were used to determine the respondents' age, gender, race, marital status, level of education and the number of years of being a customer in a particular bank. We also include 2 questions regarding behavioral factors for the respondent to rank the most important to the least important. The study uses the "Friedman non-parametric test" to see whether the respondents rank them differently.

The researchers decided to adopt the convenient sampling techniques because of two reasons:

- It is against the banking ethics to issue out the list and address of their customers.
- It is also against the (BAFIA) policies to obtain the list and address of customers of a particular bank or financial institution. (Ramayah, 2003).

These reasons compel the researchers to visit each bank during working hours to administer the questionnaires to the respondents and collect the response immediately from the customers. A total number of 50 questionnaires were distributed using an intercept survey.

RESEARCH FINDINGS

A total number of 50 questionnaires were distributed, out of which only 37 were retrieved back, in which 7 were incomplete. Thus, 7 questionnaires were discarded and only 30 questionnaires were accurately responded, thereby giving a response rate of 60%.

The profile of the respondent is presented in Table 2, in which the respondent comprised of males 18 (60%) and 12 females (40). This means that male patronize online banking more than their female counterpart. The respondents were between the age of 18 years old and above, whereby 33% are 26-35 years old, 47% are 36-45b years old. The majority of the

respondents are Bachelor and Masters Degree holders, that constituted up to 87%, this indicates that those with less education use online banking services less than the way educated people do in Malaysia. While 80% of the respondents had used the online banking for more than 2 years

.

Table 2 Profile of the respondents

Demographic		Frequency	Percentage
Gender	Male	18	60%
	Female	12	40%
Age	18 – 25 years	2	7%
	26 – 35 years	10	33%
	36 – 45 years	14	47%
	46 – 55 years	3	10%
	Above 55 years	1	3%
Education Level	Sec,school or equivalent	1	3%
	Degree or equivalent	8	27%
	Masters or equivalent	18	60%
	PhD or equivalent	3	10 %
Number of years using Online banking	< 1 year	3	10%
	2 - 5 years	11	37%
	6 -10 years	8	27%
	11 -20 years	4	13%
	> 20 years	4	13%
Marital Status Single	Single	10	33%
	Married	19	63%
	Divorced	0	0%
	Widowed	1	3%

Source: Field Survey (2012)

Sequential regression analysis was used to test the hypotheses, which is to determine the relationship between security, cost, convenience and online banking towards effective customer service delivery in the banking industry. Therefore, to determine the relationship between the independent variables (cost, convenience and security), intervening variable (online banking) and the dependent variable (customer service delivery); the study uses the hierarchical regression, so that it can provide a comprehensive explanation of the conceptual framework.

Table 3 Descriptive statistics

Descriptive Statistics

	Mean	Std. Deviation	N
CSD	4.0208	.93431	30
Cost OB	3.7556	.84615	30
Conv OB	3.9778	.97648	30
Sec OB	4.1500	.92987	30
OB	3.9667	.90168	30

Source: Field Survey (2012)

From the table above, it can be seen that the Likert-scale is from 1- 5, in which the study consider "Cost" of online banking that has the mean of 3.7556 with the lowest standard deviation of .84615.

Table 4 Correlation

		CSD	CostOB	ConvOB	SecOB	OB
Pearson Correlation	CSD	1.000	.603	.723	.851	.605
	CostOB	.603	1.000	.660	.573	.669
	ConvOB	.723	.660	1.000	.807	.859
	SecOB	.851	.573	.807	1.000	.742
	OB	.605	.669	.859	.742	1.000
Sig. (1-tailed)	CSD	.	.000	.000	.000	.000
	CostOB	.000	.	.000	.000	.000
	ConvOB	.000	.000	.	.000	.000
	SecOB	.000	.000	.000	.	.000
	OB	.000	.000	.000	.000	.
N	CSD	30	30	30	30	30
	CostOB	30	30	30	30	30
	ConvOB	30	30	30	30	30
	SecOB	30	30	30	30	30
	OB	30	30	30	30	30

Source: Field Survey (2012)

From the table 4 above, the correlation matrix is a first approximation that allows to examine the convergent and discriminant validity of the item measures for each construct. Measures for a construct should relate highly to each other and less highly to measures of other

constructs (Afrouz, 2007). Thus, all the independent variables (Cost, Convenience and Security) are significant in determining effective customer service delivery on the online banking in Malaysia.

Table 5 Model summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.863[a]	.744	.715	.49884	.744	25.244	3	26	.000
2	.875[b]	.765	.727	.48799	.020	2.169	1	25	.153

a. Predictors: (Constant), Sec OB, Cost OB, Conv OB

b. Predictors: (Constant), Sec OB, Cost OB, Conv OB, OB

Source: Field Survey (2012)

From the table above, it can be seen that from the first model when cost, convenience and security were added, then (R) of 0.863 was arrived at, while the (R^2) is 0.744 this means that 71.5% of the variability (customer service delivery) is being accounted for (cost, convenience and security), while the adjusted (R^2) is 0.715, which means that the sample size and the predictors are descent enough to determine customer service delivery. The R Square change in the first model as it could be noticed is 0.744 and is also the same with R Square of 0.744, which means that the model has started with no prediction capacity.

In the same vein, when the three independent variables were added, The result got was (R^2) of 0.744, this indicates that the R Square Change is the same thing. The Sig. F Change which is 0.000 < 0.01, this means that the (R^2) is 0.744, adjusted (R^2) is 0.715 and (R^2) 0.744 are statistically significant. From the Anova table we can see that the F Value is 25.244, which corresponded with the F change in the first model with a degree of freedom (df1) 3, which is statistically significant 0.00 <0.01, this mean that all the predictors of model (one) are highly significant in determine customer service delivery vie online banking in Malaysia.

Table 6 ANOVA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.845	3	6.282	25.244	.000[b]
	Residual	6.470	26	.249		
	Total	25.315	29			
2	Regression	19.362	4	4.840	20.326	.000[c]
	Residual	5.953	25	.238		
	Total	25.315	29			

a. Dependent Variable: CSD

b. Predictors: (Constant), Sec OB, Cost OB, Conv OB

c. Predictors: (Constant), Sec OB, Cost OB, Conv OB, OB

Source: Field Survey (2012)

From the summary table above, it can be noticed that the model (two) has a new (R) value (0.875), the increase of the value is as a result of variable (online banking) that is added into the model as the predictor variable. At the same time, the (R^2) 0.765 has also increased to a value of which means that 20% increase as a result of adding online banking in the model as the predicting capacity and this increase is as associated with the F Change Value 2.169 with 1 degree of freedom (df) and the F Change which is 0.00< 0.01 signifies statistically significant.

Table 7 Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	.171	.474		.360	.722			
	Cost OB	.186	.146	.168	1.271	.215	.603	.242	.126
	Conv OB	.009	.176	.010	.054	.957	.723	.011	.005
	Sec OB	.750	.169	.747	4.434	.000	.851	.656	.440
2	(Constant)	.295	.471		.626	.537			
	Cost OB	.242	.148	.219	1.634	.115	.603	.311	.158
	Conv OB	.190	.211	.199	.900	.377	.723	.177	.087
	Sec OB	.786	.167	.782	4.698	.000	.851	.685	.456
	OB	-.303	.206	-.292	-1.473	.153	.605	-.283	-.143

a. Dependent Variable: CSD

Source: Field Survey (2012)

From the coefficient table, it can see that the entire variables in the model one, have a (β =0.168, 0.10 and 0.747, which p < 0.01) this means that the variable are statistically significant. The second model shows that, out of the variables is only online banking that has a negative value of (β-0.292), which is not statistically significant and this means that online

banking has no direct bearing on enhancing customer service delivery in the banking industry. In the sense that customers do value the behavioral factors, such as cost, convenient and security before accepting and utilizing online banking in Malaysia.

ADDITIONAL ANALYSIS

Table 8 Result of non-parametric tests

Selected variables	Mean rank	Ranking
Cost of Online Banking	1.50	1
Convenient of Online Banking	2.02	2
Security of Online Banking	2.48	3

Source: Field Survey (2012)

However, additional analysis was conducted using non- parametric test, for the purpose of this analysis is to investigate the customers concern and to find out the most preferable behavior that really impact on customer service delivery. Malaysian customers ranked cost as the major concern for the customers in online banking. Then, followed by the level of conveniences and the last one of interest to the Malaysian customer is security. The Friedman Test is significant ($\chi 2 = 15.694$, $p < 0.01$).

DISCUSSION OF RESULTS

The primary objective of the research is to examine the behavior factors, such as cost, convenience and security on how they influence online banking in Malaysia toward effective customer service delivery. The study also examines the context of online banking toward effective customer service delivery in the banking industry.

The research has proven that, the context of online banking has no direct bearing in influencing customer service delivery, rather the behavioral factors (cost, convenience and security). This means that customers do value and satisfied with online banking ones the bank charges is low or affordable, the service is convenient or user friendly and their financial transaction is secured. On the same vein, in the long run customers may prepare for normal queuing branch banking ones they perceive the online banking is solely based on normal services rather than on putting into consideration of the behavioral factors (cost, convenience and security). This finding has also supported the findings of Musiime (2010) and Hazlina et al (2011).

The research also shows that, cost of online banking has a more significant impact than convenience and security of online banking toward effective customer service delivery. In addition, the cost of online banking is also a direct mediator between online banking and effective customer service delivery in the banking industry. This means that behavioral factors or external factors, such as cost, convenience and security have a direct impact on effective customer service delivery vie online banking. These findings buttress the finding of Suganthi (2010) and Malarvizhi (2011).

Thus, these findings have become paramount for strategic decision for the management of Malaysian banking industry to understand that, although customers do value online banking but they consider the "cost" as the most priority, followed by the convenience of online banking, then the security aspect of online banking as a gauge on intention to fully utilize online banking. This means that, banks need to develop online banking and other related product and services that are cost affordable across all customers.

However, based on the 5 Likert-scale, the mean value of 3.76 is at the high site. This indicated that majority of the customer do patronise and handle a lot of online banking transaction, which means there is the need for banks to come up with varieties of online banking product at lower cost/charges that may attract more customer, because the higher the turnover of every transaction the higher the profit of the bank, and this can only be possible if there are availabilities of product at a lower cost/charges that will attract huge amount of customers.

Thus, this research is significant in such a way that it has the potentials evidences of using the Kano's Model for effective customer service delivery in the banking industry or other similar service industry.

IMPLICATIONS FOR PRACTICE

- Due to the extensive level of globalization and competition, there is the need for banks to grab this opportunity of online banking, so that to establish wider customer base irrespective of geographical location.
- There is the need for banks to advertise and promote the level of low cost/charges as a marketing strategy to attract more customers to patronize online banking. And this promotion can be through Jingles, Road shows, TV, Radio, Internet etc.
- Moreover, it is hoped that online banking will continue to grow and play a big role in supporting the economy of Malaysia, once there is a support from the Malaysian government by coming up with stiffer sanction that would guide against online banking and other related frauds.

LIMITATION AND SUGGESTION FOR FUTURE RESEARCH

- Time constraint has resulted in getting small sample size.
- The scope of the research is only within Johor State, as such this might not be truly representative of the entire population towards effective customer service delivery via online banking.
- As most of the respondents have not used online banking for quite a long time, this may also not be a true representative of the entire population.
- The key behavioral factors are adopted from the previous research, this mean that it's possible that some vital determinant of effective customer service delivery are left behind in this research.
- This research has provided a road map for effective customer service delivery via online banking, this mean that there is the need to arouse future research on other similar related electronic banking product such as mobile banking, ATM and point of sale's terminal at a different geographical location so that to understand the reaction

of the same behavioral factors (cost, convenience and security). Thus, there is the need to intensify research on electronic banking services.

CONCLUSION

This is a research paper in progress which provides an overview of the impact of online banking services on customer service delivery in the Malaysian banking industry: using the Kano's model. The paper addresses a number of issues identified from the literature. An extensive review of the existing literatures on the impact of online banking services on customer service delivery in the banking industry were discussed.

The paper, therefore, addresses issues related to electronic banking services and behavioral factors as well as customer service delivery. It is clear that advertising alone cannot convince the non-users of Online banking to start using the services. Thus, the finding is encouraging in such a way that it provides some theoretical framework and practical insight to identify the factors and beliefs that influences customer service delivery in the Malaysian banking industry.

REFERENCES

1. Ahmad, A. E. (2011), E-banking Functionality and Outcomes of Customer Satisfaction: An Empirical Investigation. *International Journal of Marketing Studies*, Vol, 3 No 1, pp. 231-245.
2. Al-Hawari, M., Hartley, N. & Ward, T. (2005), Measuring Banks Automated Service Quality: A Confirmatory Factor Analysis Approach. *Marketing Bulletin*, 16, 2005.
3. Aliyu, A. A. (2012b), An Exploratory Study on Adoption of Electronic Banking : Underlying Consumer Behaviour and Critical Success Factors . Case of Nigeria , *Business and Management Review* Vol. 2(1) pp. 01 – 06 Vol *2No*1), pp 1–6.
4. Aliyu, A. A. & Tasmin, R (2012a). The Impact of Information and Communication Technology on Banks' Performance and Customer Service Delivery in the Banking Industry, *Int. J Latest Trends Fin. Eco. Sc*. Vol-2 No. 1 pp 80–90.
5. Anyasi, F. L. & Otubu, P. A. (2009), Mobile Phone Technology in Banking System: Its Economic Effect. *Research Journal of Information Technology*, Vol 1, No 1. pp 1-5, ISSN: 2041-3114.
6. Ardhiyani, N. (N.D.). Integrating Servqual With Kano Into Quality Function Deployment (Qfd) for Better Quality Of Services (Case Study : *Pt Pos Indonesia*), pp 1–7.
7. Berry, L. and Parasuraman, A. (1995), Service De Marketing. So Paulo: *Maltese,* 1995.
8. Bhattacharyya, S. K., & Rahman, Z. (2004), Capturing the Customer's Voice, the Centerpiece of Strategy Making: A Case Study in Banking. *European Business Review*, Vol 16, NO 2, PP. 157-172.
9. Drucker, P. (1999b), Desafiosgerenciaispara o sculo, XXI. So Paulo: *Pioneira,* 1999.
10. Drucker, P. F. (1985a), Entrepreneurial Strategies, Innovation and Entrepreneurship Practice and Principles, *Harper & Row, New York*, pp. 207-243 .
11. Hazlina, T. et al (2011), Impacts of Service Quality on Customer Satisfaction: Study of Online Banking and ATM Services in Malaysia. *International Journal of Trade, Economics and Finance*, Vol.2, No.1, pp 023.

12. Hazlina, T. et al (2011), Singapore Service Quality Analysis: An Application on Online Banking and ATM Facilities, *Proceedings of the International Conference on Economics and Finance Research Ipedr* , Vol.4 © (2011) IACSIT Press,.
13. Kano, N. et al. (1984) Attractive quality and must-be quality. Hinshitsu: *The Journal of the Japanese Society for Quality Control*, pp 39–48.
14. Khong, K. W. & Mahendhiran, N. (2006), The Effect of Customer Service Management on Business Performance in Malaysian Banking Industry: An Empirical Analysis. *Asia Pac. J. Mark. Logis.*, Vol. 18, No 2.
15. Lovelock, C. H. (1996), Services Marketing, New Jersey: *Prentice Hall*, 1996.
16. Ms Malarvizhi, V. (2011), An Analysis on the Usage of E-banking Services in Coimbatore City, *IJBEMR* Vol 2, No 1.
17. Musiime, A. (2010), Bank Clients' Perception of Information Technology Usage, Service Delivery and Customer Satisfaction: Reflections on Uganda's Banking Sector. *Proceedings of the International Trade & Academic Research Conference (ITARC) – London.*
18. Nek, et al (2009), Service Quality Dimensions, Perceive Value and Customer Satisfaction: ABC Relationship Model Testing. *IBEJ*, Vol.2 No.1. pp. 189-207.
19. Nsouli, S. M. and Schaechter, A. (2002), Challenges of the E-banking Revolution: Finance and Development*, International Monetary Fund*, Vol. 39, No 3. pp. 231-254.
20. Ombati, T. O. (2010), Technology & Service Quality in the Banking Industry Importance and Performance of Various Factors Considered in the Electronic Banking Services; *AIBUMA Publishing, African Journal of Business & Management (AJBUMA),* Vol. 1, pp. 16 .
21. Parasuraman, A., Zeithaml, V. A. & Berry, L. L. (1985), A Conceptual Model of Service Quality and its Implications for Future Research. *Journal of Marketing*, 49 (Fall), pp.41 – 50.
22. Rahmath, S., Hema, D. & Abdullah K. (2011), Internet Banking Adoption in an Emerging Economy: Indian Consumer's Perspective. *International Arab Journal of e-Technology,* Vol. 2, No. 1. Pp. 134-151.
23. Ramayah, T., Jantan, M., Nasser, M., Noor, M., Ling, K. P., & Razak, R. C. (2003). Receptiveness of Internet Banking By Malaysian Consumers : The Case Of Penang, *Asian Academy of Management Journal*, Vol. 8, No. 2, 1–29 .
24. Shirshendu, G. & Sanjitkumar, R. (2011), Generic Technology-Based Service Quality Dimention in Banking. *International Journal of Bank Marketing*, Vol. 29, NO. 2, pp. 168-189.
25. Shoebridge, M. (2005), Banking on Six Sigma to Improve Service Quality a Case Study: Major Australian Financial Institution. *Australian Banking & Finance*, Vol 14 . pp 9-10.
26. Suganthi, B. A. (2010), Internet Banking Patronage: An Empirical Investigation of Malaysia. http://www.arraydev.com/commerce/jibc/0103_01.htm

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE INNOVATION FROM BUYER AND SUPPLIER'S COLLABORATION

Ya Ling Tsai, Department of Marketing and Logistics Management, Southern Taiwan University of Science and Technology,
Rebecca@mail.stust.edu.tw

Huei-Ying Chen, Department of Marketing and Logistics Management, Southern Taiwan University of Science and Technology,
Stella0523@mail.stust.edu.tw

ABSTRACT

Purpose: *The goal of this research is to investigate the innovation between buyer and supplier's collaboration in order to create the values. The first one is the research identify that innovation elements between buyer and supplier' collaboration on cost down on the switching costs, new product performance, and create a new market.*
Design/methodology/approach: *This study is focus on the literature review which approaches on the generation the innovation from buyer and supplier's collaboration within value. Nevertheless, the switching casts focus on the transaction cost which builds up the buyer and supplier's relationship. The new product performance generate from the collaboration of buyer and supplier. Furthermore, the employment of buyer and supplier's collaboration to create a new market together. From above, those of outcomes come from buyer and supplier's collaboration on the innovation. It without doubt, after the buyer and supplier's collaboration's value readily lie in their innovation base on the advantage.*
Findings: *From this research, we discuss the value on the innovation that to find out the factors from buyer and supplier's collaboration. There are two points of this study: one is to find out what is the really value from buyer and suppliers' collaboration, the other one is to explore how to innovation from the buyer and supplier's collaboration.*
Originality/Value: *We expect to find further value and the way of innovation work together from buyer and supplier's collaboration.*

Keywords: Innovation, buyer and supplier's collaboration, value

INTRODUCTION

Taiwanese business firms famous on the high technology supply chain management. Yet, they were doing the ODM (Own Designing and Manufacturing) and OEM (Original Equipment Manufacturing) before. This mean they do not have own innovate products and services. Recently, they are prefer to have own brand by themselves. That is pushing they must have to create the new products. That is why this research to do the innovation from the supply chain channels. If they have a very good relationship to does the collaboration from supply chain channels? Recently, business firms focus on the innovation and collaboration with their suppliers. That is why we are going to do the topic for buyer and suppliers' collaboration for innovation.

This research structure is to identify those innovation elements between buyer and supplier' collaboration on cost down on the switching costs, new product performance, and create a new market. The first one, this study is focus on the literature review which approaches on the generation the innovation from buyer and supplier's collaboration within value. Nevertheless, the switching casts focus on the transaction cost which builds up the buyer and supplier's relationship. The new product performance generate from the collaboration of buyer and supplier. Furthermore, the employment of buyer and supplier's collaboration to create a new market together. From above, those of outcomes come from buyer and supplier's collaboration on the innovation. It without doubt, after the buyer and supplier's collaboration's value readily lie in their innovation base on the advantage.

Findings parts: From this research, we discuss the value on the innovation that to find out the factors from buyer and supplier's collaboration in the next step but not from this papers. The reason is the interview companies and their collaborate partners still are looking. However, there are two points of this study: one is to find out what is the really value from buyer and suppliers' collaboration, the other one is to explore how to innovation from the buyer and supplier's collaboration.

The innovation is difficult on the attitude of fail from business firms. If they do the innovation is not successful after they invest the resource. That is many parts can to discovery for this research.

BUYER AND SUPPLIERS' COLLABORATION ON UNNOVATION

The innovation comes from consumers attracted by the newfangled products. How can the firms to recognize the consumers' desires? Business firms can work with their suppliers on this issue. Those follows literature review is going to discuss it:

Sivakumar *et al*., (2011) said that global innovation generation focus on the alliance from any types which to examine the performance. This can explain the innovation need the business firm collaboration together, as like suppliers, buyers and wholesalers. They can collaborate on the materials innovation from suppliers. The suppliers suggest what kind of materials can use for the products in order to add the profits. Another proposes is about the style of new products, suppliers are able to design it, how to manufacture and know the advantage for the factories. This about the processes of manufactured goods on innovation. The other collaboration approach is the buyer look for the collaborate suppliers is not only provide the lone material. The buyer anticipates their suppliers can do integrate materials or semi-finished goods to support them. That can see the larger to larger industrial model to emerge based on their large suppliers from the brand business firms.

Stock *et al*., (2012) suggest the business firms' strategy focus on resources from collaborate culture for innovation. The reason is the firms' collaboration with their business partners can do more things. The collaboration's teams work together on many issues. This is about innovation on which part; it could be the materials' innovation, the products' innovation, and marketing. The firms' suppliers can support it, it will be to discover the new material or design the new products. Furthermore, the business firms' collaboration culture for innovation needs to deeply to practice it. This involves the buyer and suppliers' collaboration's motivation. The buyer and suppliers need to think the negotiation for their collaboration. The other thing is how to integrate their suppliers to do the collaboration. However, the collaboration is able to get more advantage for buyer and suppliers, such as to create the new products and marketing.

Stanko *et al*., (2013) referred three demand-side features which on the switching costs, customer preference stability and network externalities. They found from experiential research the new product development on the innovation regard as the three elements to prove it. The switching cost is effects on the early applicant are better to generate the innovation. When customers trust the business firms from innovate products in order to steadiness and link the networks. This observes from the demand side but have the benefits from supply sides.

Mishra and Slotegraaf (2013) pointed that even scholars reflect why business firms to rely on the poor performance and cannot to do the innovation to increase their competitive advantage. Nevertheless, firms have to identify the value from advantage.

On the other hand, the business firms fear the innovation is not successful so that they don't want to do the innovation sometimes. They consider they spend a lot of resources and then to do the innovation. This is not only the suppliers but also buyer do the collaboration for the innovation. It is without doubt when the firms would like to do the innovation and collaborate firms need to work together. Their research and development employee, purchasers, marketing have to work about it. How do the marketing reflection? How to manufacture the products from new materials? In addition to this, they invest the innovation issues and desire to make out the good result. Yet, it is huge stressful for the innovation team, especially they do not know whether or not successful. That is why Stanko *et al.,* (2013) referred that business firms can get the innovation from a competitive advantage and dissimilar kind of acquirements from the result of innovation. Therefore, business firm must to have the ability to do the innovation in order to get the position advantage. It can be seen, the buyer and supplier collaboration on the innovation is very significant.

COLLABORATION

The buyer and supplier also can works on the innovation; as like Soosay (2008) defined that *"Collaboration in supply chains is important for innovation as partners realize the various benefits for innovation such as high quality, lower costs , more timely delivery, efficient operations and effective coordination of activities".* This can say collaboration increase the supply chain partners do more effective operations on the innovation in order to increase the supply chain management efficient. That is can see from Soosay (2008) referred "*Management was conscious of the need to determine and priorities efforts to save costs and satisfy customers and at the same time collaborate for efficient allocation of resources throughout the supply chain".*It can see the collaboration though the supply chain management is very important and also can create the innovation issues from it.

In addition to this, Perks and Moxey (2011) said *"Product innovation requires the division and sharing of tasks and resources".* When the firms do the innovation for the products and can share their resource for supply chain members. On the other hand their referred that *"This approach leads to high innovativeness of the lead firm, but the network as a whole is not utilized for innovation activities. We find that network partners are unlikely to go beyond what is necessary to carry out specified tasks."* The innovation may not to be a network

because of it is confidential issues within supply chain. Furtherer, Fang *et al*., (2011) explains "*Relationship learning is a special type of interorganizational learning. Interorganizational learning may be based on either collaborative relationship or arm's length relationship".* It will be a special relationship as like they pointed out *"That is, organizations need to excel in both types of innovation instead of focusing on only one at the expense of the other. Therefore, exploring the factors that enable firms to engage simultaneously in both types of innovation is a critical issue"*. Nevertheless, the collaboration is very important within supply chain management.

It is without doubt, Corsaro *et al.*, (2012) said *"Innovation is acknowledged by practitioners, policy makers and academics as a vital element for most companies and nations' competiveness and growth".* The innovation is not only focus on the supply chain channel but also cross the nations. It can to be cross the nations to do the innovation together from supply chain partners.

METHODOLOGY INTENDED FOR CASE STUDY RESEARCH

This research is going to do the case studies survey. The case study referred from Cassell and Symon (1995) comment that *"Case study research consists of detailed investigation, often with data collected over a period of time, of one or more organizations, or groups within organizations, with a view to providing an analysis of the context and processes involved in the phenomenon under study* ". This phenomenon related to the research question in order to find out the research answers. The collected data in case studies depends on the members of the organizations. The case studies include one or two more business to do the survey and then interview and observe their supply chain partners who have some relationship or do the innovation with their bossiness firms. By the way, the interview case studies need to be different business firm and then can do more survey from dissimilar point views. During a period of time, a survey is conducted within the organizations, or the prior data and history are collected in order to analyze the organizations' context and processes.

On the other hand, the case studies can employ to do the quantity and qualitative research method. Yet, this study is going to do the qualitative research. Carson *et al.,* (2001) pointed out the qualitative research methods: in-depth interviewing and convergent interviewing; case-based studies; focus group interviews; ethnographic studies; grounded theory; action research and learning. They referred that case studies usually focus on research problems relating to '*how and why*?' It is more significant to find implications rather than conclusions. The reason for this is that case study research is based on "*how and why*". In addition to this,

they also point that "*Qualitative research is suitable where the research emphasis is on in-depth understanding of how, why and in what context certain phenomena occur; and what impacts upon or influences such phenomena*" (Carson *et al.*, 2001, p.66). It argues about the related compounds, social science and what the research wants to know. Consequently, case study research is descriptive research that integrates and gives details from inside to outside the situation of the cases. The description of the answers to the research questions how and why are not only in a straight line from one to another, but include many phenomenon factors in orders to answer the research questions. It is also linked to many factors that are the findings in case study research.

Yin (2003, p.1) said that *"The case study is but one of several ways of doing social science research. Other ways include experiments, survey, histories, and the analysis of archival information. Each strategy has peculiar advantages and disadvantages, depending on three conditions: (a) the type of research question, (b) the control an investigator has over actual behavioral events, and (c) the focus on contemporary as opposed to historical phenomena".* That is why he said that case study research strategy contributes to the information about individuals and groups, and organizational, social, political, and related phenomena. The case study is focused on relations and processes. As Denscombe (1998) said, it is within a social environment to develop what is the one thing related to the other necessary features and how the other is a variety of things linked. It is not only the internal organizational features but can also be discovered from the external organization in terms of its social behavior.

The strength of case studies is that they can deal with a full variety of evidence from documents, facts, interviews, and observations in a historical study. In addition to this, the case studies collect primary data and focus on the particular organizations in a deeper interview within the context of this research method.

This research is going to finding the buyer and supplier collaboration with innovation, the first need to understand the motivation for buyer and supplier work together and how do they desire to innovation the products or service in order to create the new markets. The second one is to discover how to collaborate with their supply chain partners and what the way to collaborate together in order to find out the model for buyer and suppliers' collaboration from supply chain channels. The final issues to combine the innovation and collaboration elements and then to detection the result for buyer and supplier collaboration from innovation issues in order to fit the research questions and have a findings for practice and academic to review the innovation topic.

LIMITATIONS OF THE STUDY

This research limitation divides to two parts as follow:

The first one is the lack of agreement on theory and fieldwork generalizations from the findings. The reason is Taiwanese business firms famous on the high technology supply chain management. Yet, they were doing the ODM (Own Designing and Manufacturing) and OEM (Original Equipment Manufacturing) before. This mean they do not have own innovate products and services. Recently, they are prefer to have own brand by themselves. That is pushing they must have to create the new products. That is why this research to do the innovation from the supply chain channels. If they have a very good relationship to does the collaboration from supply chain channels? Conversely, the location of geography is limited. The fieldwork has a specific context so that it may not be suitable to generalize the findings to the field of buyer and supplier collaboration for other parts of the world. The presentation of these findings is expected to be of benefit to business firms who wish to increase their buyer and suppliers collaboration for innovation.

Therefore the findings lack more detailed discussion of operations between buyer and suppliers collaboration operations and process. The main limitations of this study are due to the interview time available, making it difficult for the researcher to observe the buyer and suppliers' collaboration for innovation. The other reason is that buyer and suppliers' business firms' work with the innovation topic confidential and the supply chain partners wished to remain anonymous. This meant having some limitations on the data and references presented in the findings sections.

REFERENCES

1. Cassell, C., and Symon, G. (1995), *Qualitative methods in organizational research: a practical guide*, Sage publication Ltd., British.
2. Carson, D. Gilmore A., Perry C., and Gronhaug, K. (2001), *Qualitative Marketing Research*, Sage Publications Inc, British.
3. Chu (2009), "The influence of family ownership on SME performance: evidence from public firms in Taiwan", *Small Bus Econ*, Vol.33, pp.353-373.
4. Corsaro D., Ramos C., Henneberg S.C., and Naude P., (2012), "The impact of network configurations on value constellations in business markets--- The case of an innovation network", *Industrial Marketing Management*, Vol.41, pp.54-67.
5. Denscombe, M. (1998), *The good research guide for small-scale social research projects*,

Open University Press, UK.

6. Fang S.R., Fang S.C., Chou C.H.,Yang S.M., and Tsai F.S., (2011), "Relationship learning and innovation: The role of relationship-specific memory", *Industrial Marketing Management*, Vol.40, pp.743-753.
7. Mishra S., and Slotegraaf R.J.,(2013), "Building an innovation base: exploring the role of acquisition behavior", *Journal of Academic Marketing Science.* 10.1007/s11747-013-0329-6, on line published 01.Feb.
8. Perks H., and Moxey S., (2011), "Market-facing innovation networks: How lead firms partition tasks, share resources and develop capabilities", Industrial Marketing Management, Vol.40, pp.1224-1237.
9. Sivakumar K., Roy S., Zhu J.J., Hanvanich S., (2011), "Global innovation generation and financial performance in business-to-business relationships: the case of cross-border alliances in the pharmaceutical industry", *Journal of the Academic Marketing Science*, Vol.38, pp.757-776.
10. Soosay C.A., Hyland P.W., and Ferrer M., (2008),"Supply chain collaboration: capabilities for continuous innovation", Supply Chain Management: An International Journal,Vol.13,No.2,pp.160-169.
11. Stanko M.A., Bohlmann J.D., and Molina-Castillo F.J., (2013), "Demand-side inertia factors and their benefits for innovativeness", *Journal of the academic Marketing Science.* 10.1007/s11747-013-0332-y, on line published 01.Feb.
12. Stock M.R., Six B., and Zacharias N.A., (2012), "Linking multiple layers of innovation-oriented corporate culture, product program innovativeness, and business performance: a contingency approach", 10.1007/s11747-012-0306-5, on line published 08.Jun.
13. Yin, R.K. (2003), *Case study research: Design and Methods*, Third Edition, Sage Publications, Inc, USA.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

TQM AND FAMILY OWNED BUSINESS: PERFORMANCE AND SUSTAINABILITY

Boon In Tan, Universiti Tunku Abdul Rahman, Malaysia.

Kee Luen Wong, Universiti Tunku Abdul Rahman, Malaysia.

Chee Keong Choong, Universiti Tunku Abdul Rahman, Malaysia.

ABSTRACT

TQM or total quality management is a continuous practicing philosophy that could trace its origin from Feigenbaum in 1951 (Martinez-Lorente et al., 1998) where he defines Total Quality Control (TQC). Whereas Miller et al (2007), summarised the definition of family owned business to be as simple and straight forward as, "one in which multiple members of the same family are involved as major owners or managers, either contemporaneously or over time."). According to Zhang (2000), organizational performance consists of four important dimensions, namely employee satisfaction, customer satisfaction, product quality and strategic business performance. On the other hand, performance could be measured in terms or shareholder returns, growth rate (both profit and revenue), market value of a firm and return on equity etc. It is not easy to single out the growth factor in each enterprise and its driver to assess its performance. In this paper, we assume the firm's performance also implies the growth performance. A better performance of family owned business would be significant as it is widely acknowledged that one of the main objectives of the family owned business is to past down the wealth and business from generation to generation, thus the sustainability objective is of the main agenda for business continuity.

Keywords: Family owned business, TQM, organization performance, sustainability.

.

INTRODUCTION

The search for factors that drive business organizational performance has been one of the key areas where many scholars as well as practitioners have a keen interest and attempts to identify the answer. In the process many answers have been found but many questions just as well have been raised. The truth answers could be as elusive chasing the shadow such as the presence of mediating (for example right strategy and practices) and moderating factors (for example life cycle of organization), or as obvious as everything under the sun such as effective strategy and good management practices. The actual answers are probably lying in the middle.

TQM

TQM, is widely accepted as a continuous practicing philosophy for the improvement of organization. There were many suggestions to which where the origin of TQM or total quality management came from? Martinez-Lorente *et al*. (1998) believe that we could trace TQM's origin from Feigenbaum in 1951 where he defines Total Quality Control (TQC) as:

> "*An effective system for integrating the quality development, quality maintenance and quality improvement efforts of the various groups in an organization so as to enable production and service at the most economical levels which allow for full customer satisfaction*".

In searching for defining the constructs, drivers or dimension to define and the suitable approach toward TQM, many scholars such as by Mehra et al. (2001), Brah *et al*. (2000); and Prajogo and Sohal (2003) have listed out elements such as management structure, (Mehra et al, 2001) quality tools, supplier support, customer orientation and environmental focus; (Brah et al, 2000) top management support, customer focus, employee involvement, employee training, employee empowerment, supplier quality management, process improvement, service design, quality improvement rewards, benchmarking, cleanliness and organization; and (Prajogo and Sohal , 2003) leadership, customer focus, strategic planning, information sharing, process management and human resource focus. In this regards, framework adopted from MBNQA (Malcolm Baldrige National Quality Award), with six TQM constructs for our study (i.e. leadership, strategic planning, customer focus, human resource management, process management and information and analysis) they have been identified as key elements in TQM adoption in both manufacturing and service organizations (e.g. Powell, 1995; Hoang et al., 2006) and at the same time represent the hard and soft principles of TQM discovered in the literature review (e.g. Dale, 1999; Prajogo and Sohal, 2003).

FAMILY OWNED BUSINESS

The importance and influence of family owned business in the trade and economy has gained attention from various segment of the society. For example, according to the statistics from the Family Enterprise Centre, University of Pittsburgh, it is believed, family owned business make up 50% of the GDP (Gross Domestic Product) in the USA and 60% of the country's employment. (Damast, BusinessWeek 2007). And among the emerging economies, Malaysia as an example, 70% of the public listed in Malaysia is family owned. (Amran and Ahmad, 2010). Furthermore, Ibrahim and Samad (2010) stated that the list of the 40 richest Malaysians in 2008 is mainly from the family based business entity; of which, 27 are family based and account for 67.5% of the top 40.

The contribution towards the society from family owned business also received recognition from the academic circle. For examples, some renowned universities have set up research centres which focus on this area. For example Wharton School with their Wharton Entrepreneurship and Family Business Research Centre, IMD with its IMD Family Business Centre and Australian Centre for Family Business, Bond University just to name a few examples.

Chrisman et al (2005) describe that the definition of family business can be anchored from four corners, (1) family's influence over strategic direction of a firm; (2) the intention of the family to keep control; (3) family firm behavior; and (4) unique inseparable, synergistic resources and capabilities arising from family involvement and interaction. On the other hand, Chua et al (1999) defines family business as " a business governed and managed by with the intention to shape and pursue the vision of the business held by a dominant coalition controlled by members of the same family or small number of families in a manner that is potentially sustainable across generation of the family or families." Chua et al (1999) believe

that the definition should take into account of the behavioral and intention aspect of the business, which is viewed to be different from non-family firms. Similarly, based on extensive literature review, Pramodita (1999) proposed that, family business is a business governed and/or managed with the intention to shape and pursue the vision of the business held by a dominant coalition controlled by members of the same family or a small number of families in a manner that is potentially sustainable across generations of the family or families. By these definitions, if the intention is clearly to make the said business sustainable across generations, even the businesses that are not owned but managed by a family with the intention of sustainability across generations, fits into this definition. On the other hand, family that owned and managed a business but without the intention of sustainability across generations are being excluded.

Family Owned Business Performance and Sustainability

There were many research being carried out to assess the performance of a business organisation. Performance could be measured in terms or shareholder returns, growth rate (both profit and revenue), market value of a firm and return on equity etc. In the family owned respect, based on Chrisman et al (2005), it is the intention of the family owner to past down the business to the next generation. And with this, we infer that the sustainability is one motivation factor for the owner to manage the family owned business well for future succession. For the business to be sustainable and complete with succession, the family owned business has to perform well within the competitive market environment (Statfford et. al 1999, Bocatto, Gispert & Rialp 2010).

There were many arguments over the performance of family owned business especially in terms of comparison with non-family owned firms (Gallo, Tapies and Cappuyns, 2000; Anderson and Reeb, 2003; and Miller et al (2007)). The contradictory results are often due to the sample size, sample definition (mainly due to the definition of what constitute family business), stage of organisation life cycle and size, and share of ownership. More often than not, most research find it difficult to really eliminate the external factors such as industry factor, politics and economics or stock market performance to specifically single out the performance or non-performance was solely due to the family factor (Dyer Jr. 2006). On the other hand, Villalonga and Amit (2004) concluded family firms only create value (performance) when the founder holds the main position such as the CEO or Chairman of the company with hired a CEO. They also specifically pointed out the descendant managed family firms have a tendency to destroy value, thus raised the concern of meaningful succession issues when the firms could not last longer than intended. Meanwhile, in a recent report from Ernst and Young (2012), two third of the respondent in a major worldwide survey on family owned business intends to keep the business across the generations. In the same report, one respondent who owns a major construction company in UK opined that sustainability is about succession (continuity) “Sustainability is a complex term with several different aspects. For a start, it is about succession, which is an almost which is an almost a continuous process for a family firm.”

The Sustainable Family Business Theoretical Model

Stafford et. al 1999 proposed a sustainable model that takes into consideration of business success and functionality. The model is summarised below:

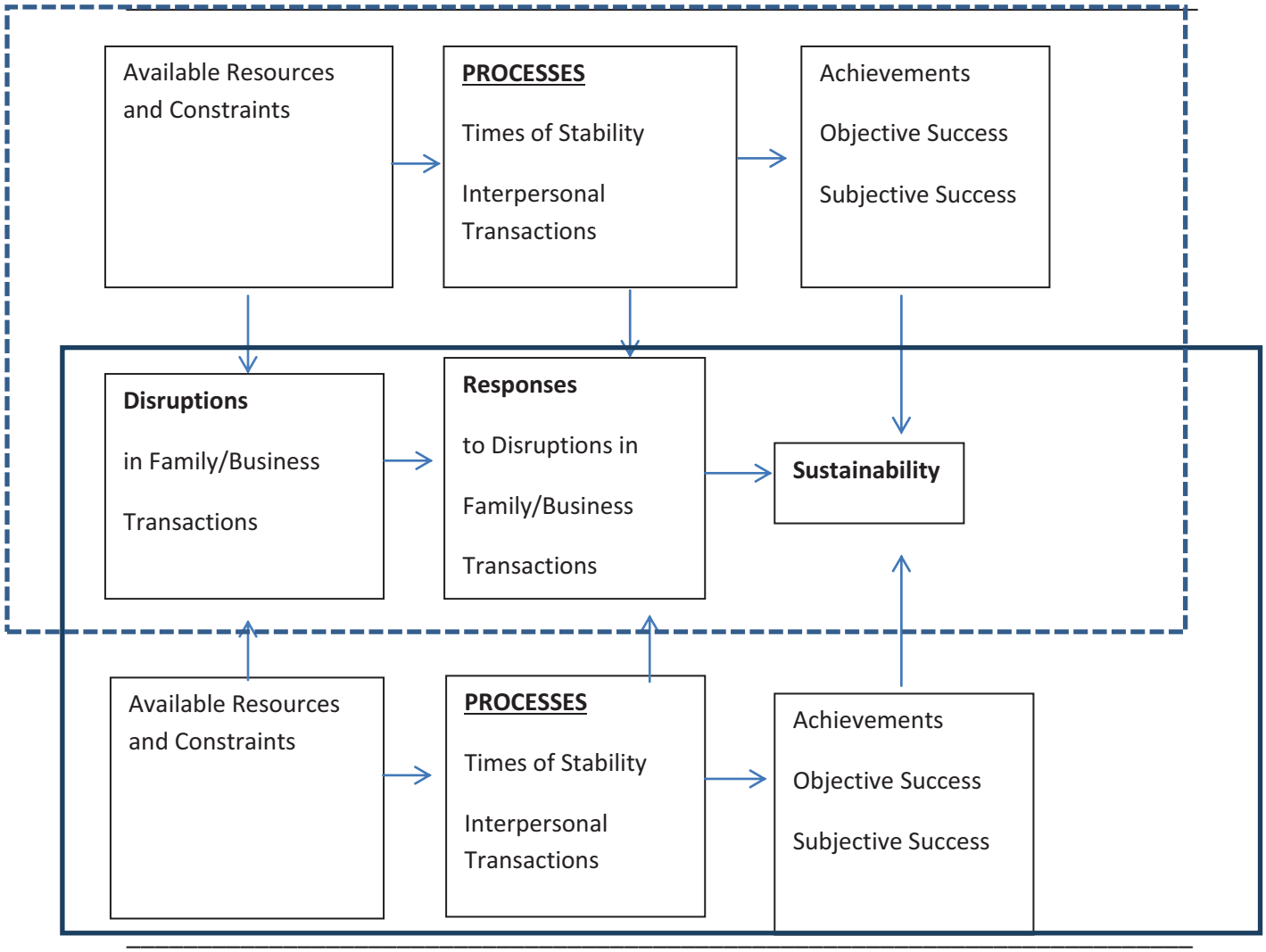


Figure 1: Sustainable Family Business Theoretical Diagram Family

The SFBRM (Stafford Family Business Research Model) theory suggests that it is important to take note of the interaction between personal transactions and resources from the business itself or from the family may facilitate or inhibit family sustainability, especially in the event responses to the disruptions internally (managerial business) and externally (environment). The better the family's reaction through the interpersonal process manage the changes and constraints, the better with the sustainability outcome. It is a model that place importance of the family function as well as business factor in terms of sustainability of the business.

TQM and Family Owned Business Performance

Separately, Tan (2013) has proposed a model showing the relationship between TQM constructs and organizational performance. In the similar context, the organizational context includes family owned business organization.

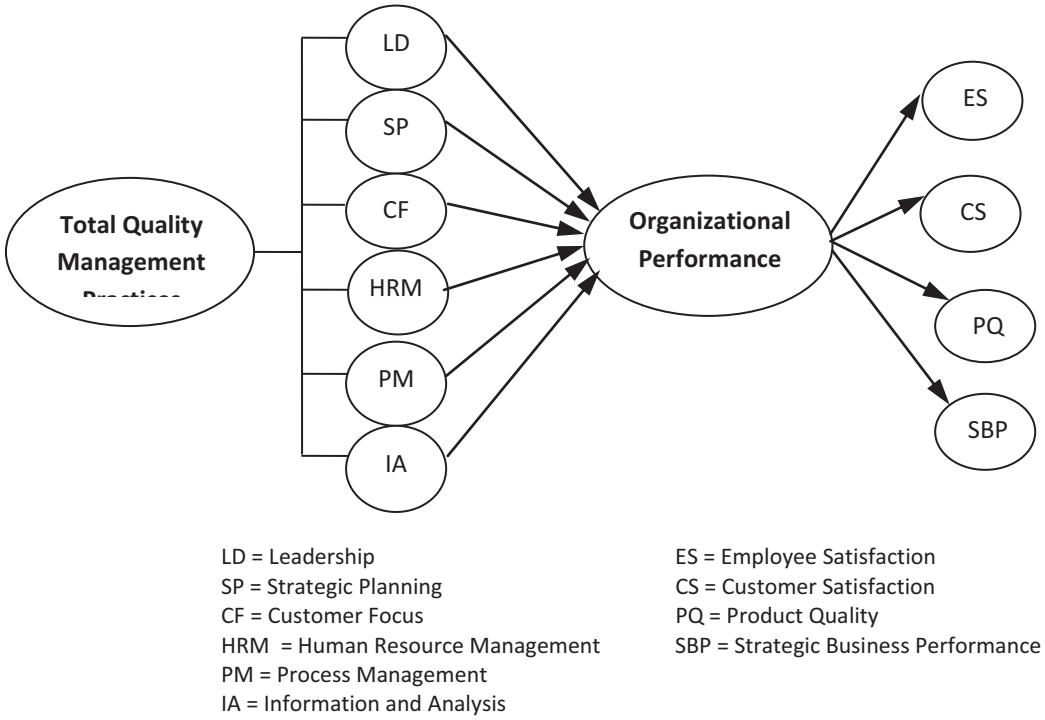


Figure 2: Structural Model of TQM Practices and Organizational Performance

In this proposed framework, it is suggested that the identified six constructs namely leadership, strategic planning, customer focus, human resource management, process management and information analysis have an impact on organisational performance which will be reflected or measured through employee satisfaction, customer satisfaction and product quality and strategic business performance. In an earlier study, Ellington, Jones and Deane (1996) have concluded in their study that family owned firms with the highest performance are also found to be adopting TQM more holistically. In a case study on a big family owned supermarket chain in Spain, Miguel (2012) has also concluded TQM approach has helped the firm to achieve spectacular results with profitable growth as well as able to face challenging situation of economic crisis (from 2008 to 2011).

TQM, PERFORMANCE AND SUSTAINABILITY

From the discussion and literature above, we propose that the following framework for family owned business sustainability with the TQM adoption;

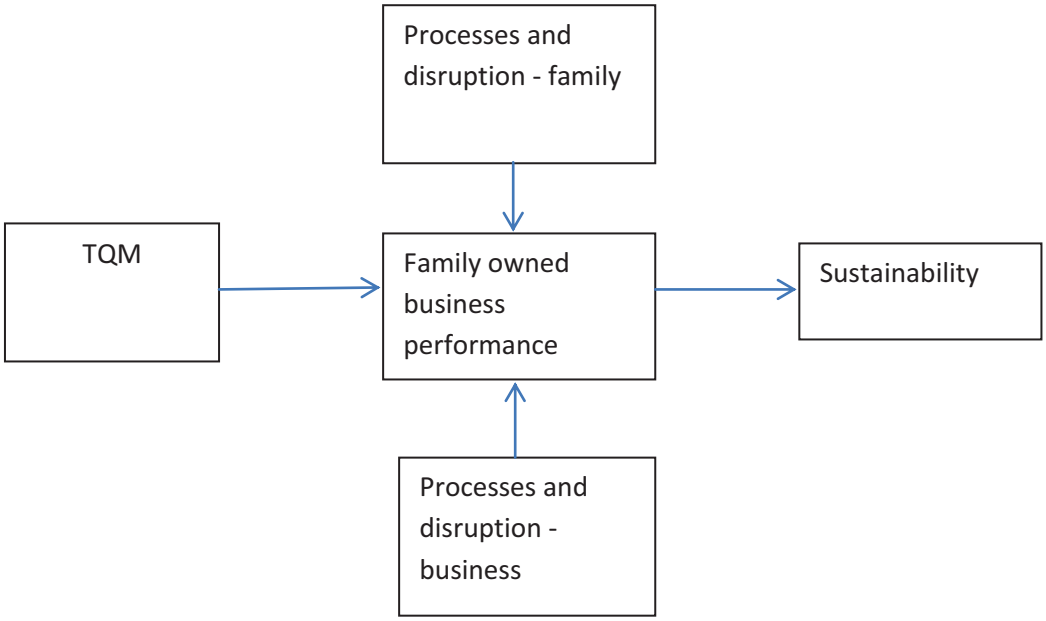


Figure 3: TQM, Family Owned Business Performance and Sustainability

As the family owned business is an entity cannot do without the influence of family element and interact with the resources and constraints in business, the injection of TQM practices to enhance the family owned business performance would provide further avenue for improving the family owned business performance and thus its sustainability. From various research TQM practices are believed to improve the organizational performance

CONCLUSION

One key differentiation of family owned business from the non-family owned business is the uniqueness of succession plan and its sustainability. This paper proposed a framework and TQM as a management tool to further enhance family owned business performance taking into consideration the interaction of family resources and constraints as well as the business resources and constraints to achieve such unique objective (succession and sustainability through better organizational performance). The proposal from this paper is nevertheless needs to be further researched through proving from empirical research and model validation.

REFERENCES

1. Amran N.A, and Ahmad A.C. (2010) "Family Succession and Firm Performance among Malaysian Companies', *International Journal of Business and Social Science* Vol. 1 No.2; November 2010)
2. Anderson, R.C., Reeb, D.M. (2003), "Founding-family ownership and firm performance: evidence from the S&P 500". *Journal of Finance 58*, 1301–1328.
3. Bocatto E., Gispert C., & Rialp J. (2010), "Family Owned Business Succession: The Influence of Pre-performancein the Nomination of Family and Non-family Members: Evidence from Spanish Firms", *Journal of Small Business Management*, 2010, 48(4), pp. 497-523.
4. Brah, S.A., Wong, J.L. and Rao, B.M. (2000), "TQM and business performance in the services sector: a Singapore study", *International Journal of Operations & Production Management*, Vol. 20, No. 11, pp.1293–1312.
5. Chirsman J.J., Chua. J.H. and Sharma P. (2005), "Trends and Directions in The Development of a Strategic Management Theory of the Family Firm", *Entrepreneurship Theory and Practice*, Sept 2005.
6. Chua, J. H., Chrisman, J.J, & Sharma P., (1999), "Defining The Family Business by Behavior". *Entrepreneurship Theory and Practice,* June, 1999.
7. Damast A. (2007), "All in the Family", *Businessweekl,* 11 April 2007.
8. Dyer Jr. G. W. (2006), "Examining The 'Family Effect' on Firm Performance", *Family Business Review*, Vol XIX, no. 4, Dec 2006.
9. Ellington E.P., Jones R.T. and Deane R. (1996), "TQM Adoption Practices in the Family-Owned Business", *Family Business Review*, March 1996 Volume 9 Issue 1, Page 5-14,
10. Ernst and Young (2012), "Built to last, family business leads the way to sustainable growth", Family Business Centre of Excellence, Ernst and Young
11. Gallo, M.A. Tapies, J. and Cappuyns, K (2000), "Comparison of family and non-family business: Financial logic and personal preferences", IESE Business School Research Papers 2000.
12. Hoang, D.T., Igel, B. and Laosirihongthong, T. (2006), "The impact of total quality management on innovation, findings from a developing country", *International Journal of Quality & Reliability Management*, Vol. 23, No. 9, pp.1092–1117.
13. Ibrahim, H. and Samad, F.A. (2010) "Family business in emerging markets: the case of Malaysia", *African Journal of Business Management*, Vol. 4, No. 13, pp.2586–2595.
14. Martinez-Lorente, A.R., Dewhurst, F. and Dale, B.G. (1998), "Total quality management: origins and evolution of the term", *The TQM Magazine*, Vol. 10, No. 5, pp.378–386.
15. Mehra, S., Hoffman, J.M. and Sirias, D. (2001), "TQM as a management strategy for the next millennia", *International Journal of Operations and Production Management*, Vol. 21, No. 5/6, pp.855–876.
16. Miguel Blanco Callejo (2012), Using Total Quality Management Model to Face the Economic Crisis: The Case of Mercadona, *Quality Management and Practices*, Dr. Kim-Soon Ng (Ed.), ISBN: 978-953-51-0550-3, InTech, Available from: http://www.intechopen.com/books/quality-management-and-practices/using-total-qualitymanagement-to-face-the-crisis-the-case-of-mercadona
17. Powell, T.C. (1995), "Total quality management as competitive advantage: a review and empirical study", *Strategic Management Journal*, Vol. 16, No. 1, pp.15–37.

18. Prajogo, D.I. and Sohal, A.S. (2003), "The relationship between TQM practices, quality performance, and innovation performance: an empirical examination", *International Journal of Quality & Reliability Management*, Vol. 20, No. 8, pp.901–918.
19. Stafford K., Duncan K.A., Dane S. & Winter M (1999), "A Research Model of Sustainable Family Business", *Family Business Review*, Vol. 7, no. 3, Sept. 1999.
20. Tan B.I. (2013), "TQM adoption and organisational performance of family owned businesses: a literature review and proposed structural model", *International Journal of Modelling in Operations Management*, Volume 3, Number 1/2013
21. Villalongaa B. and Amit R. (2006), "How do family ownership, control and management affect firm value?" *Journal of Financial Economics 80* (2004/2006)

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

CUSTOMER DEFINITION AND REPRESENTATION IN MARKET-DRIVEN PRODUCT DEVELOPMENT

Jukka Majava*, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610, FI-90014, Finland, jukka.majava@oulu.fi

Jouko Nuottila, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610, FI-90014, Finland, jouko.nuottila@oulu.fi

Harri Haapasalo, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610, FI-90014, Finland, harri.haapasalo@oulu.fi

Kris M.Y. Law, Department of Industrial and Systems Engineering, Hong Kong Polytechnic University, Hong Kong, China, kris.law@polyu.edu.hk

ABSTRACT

Purpose: *Customers are typically considered the most important external stakeholders for companies. This study explores how customers are defined by product management and development managers in market-driven development. In addition, customer representation during development is studied.*
Design/methodology/approach: *The literature review of the study focuses on customer definition and involvement in product development context, while the empirical part explores industry practices at managerial level through case projects in selected organisations.*
Findings: *Company management and strategy outline customer definition. Product management collaborates with various stakeholders including marketing, sales, management, direct customers, and end-users in customer definition. Product management was found to be the most important customer representative for product development. However, other information sources are also utilised.*
Research limitations/implications: *The case projects may not be able to offer a generalised picture of the topic. Future work should extend the study to cover more industry sectors and companies at various tiers and regions.*
Practical implications: *Company management and strategy must provide proper guidance for customer definition, and management must ensure that product management teams are appropriately resourced and competent. Systematic way of working and good collaboration among product management, product development, and other internal stakeholders is needed. While focus on selected customers is important, other customers in the value chain must also be considered. Product management and development professionals should also have some direct contact with external customers to ensure proper customer understanding and to tackle problems related to conflicting internal stakeholder views.*
Originality/value: *Past literature emphasises customer orientation, however, it has not adequately addressed how customers are defined and who represents the customers in*

market-driven context. The study findings offer a good reference for companies to improve product development focus.

Keywords - Product development, new product development (NPD), product management, customer, market-driven

INTRODUCTION

Customers are typically considered the most important external stakeholders in product development. Understanding market and customer needs is claimed to be a prerequisite for product success (Cooper, 2011). Customer orientation can be considered part of market orientation strategy together with competitor orientation and inter-functional coordination, and approaches to understand customer needs are proposed in generic product development models (Cooper, 2011; Narver and Slater, 1990; Ulrich and Eppinger, 2000). However, many companies operate in global markets with increasingly complex products and diverse market needs, which demands special attention to methods for fulfilling market and customer requirements.

Product management (PM) aims for customer satisfaction and long-term value for the company via continuous optimisation and renewal of product portfolio. PM consist of various elements, such as product and customer analysis including identification of both stated and unstated customer needs, understanding competitor offerings, roadmapping, strategic management and vision. More operational elements of PM include, for example, product lifecycle management, internal and external collaboration, release planning, and requirements elicitation, prioritisation and management (Lehmann and Winer, 2002; Maglyas *et al.,* 2012).

The objective of requirements engineering (RE) in software development is to ensure a product which satisfies customer and user needs (Kauppinen *et al.,* 2004). Requirements typically come from customers, other stakeholders, and technology related factors. They often change during the project making the nature of RE process iterative (Mottonen, 2009). RE activities cover elicitation, analysis, validation, negotiation, documentation, and management, where elicitation focuses on identifying information sources and requirement discovery (Sommerville, 2005).

In market-driven context products are typically offered to a large number of customers instead of a specific one who decides the functionality. Special needs of market-driven product development (MDPD) include balancing different requirements types, market-pull and technology-push trade-off, and release planning and requirements selection (Fogelstrom *et al.,* 2010). Large number of requirements flow continuously from various internal and external sources, for example, marketing, sales, customer care, users, and customer studies (Gorschek *et al.,* 2012; Kotler and Keller, 2009).

Despite many studies on market and customer orientation (Alam, 2005; Cooper, 2011; Griffin, 2005; Narver and Slater, 1990), past literature has not adequately addressed how customers are defined and represented in market-driven product development. This study explores how product management and development managers define customers in market-

driven development. In addition, customer representation during development is studied. Accordingly, this paper addresses the following research questions:

1. How customers are defined in literature and by product management and development managers in market-driven product development?
2. Who are the customer representatives in development?

This paper addresses the research questions both through literature and empirical study. The literature part focuses on customer definition, role, and involvement in product development. Literature synthesis is presented as a conceptual framework. The empirical study covers industry practices at managerial level through case projects in selected organisations. After the analysis, conclusions are made.

LITERATURE

1. Customers

Customers, also known as clients, purchasers, and buyers, are organisations or parts of it, either a business-to-business (B2B) customers or an end-user consumers, that may benefit from the offering a company provides (Christ, 2009; Peppers and Rogers, 2011). Customers can be current or potential, and all others with problems and needs who seek either product or service solutions (Griffin, 2005). From a manufacturer's point of view, customers include distributors, retailers, and persons who buy products from the retailers (Caplan, 2001).

The customer relationship can be direct or indirect, and the customer may be a paying or non-paying one. Customers may also participate in value creation (Prahalad and Ramaswamy, 2004). Besides external customers, internal customers affect product quality, and should be involved in development early enough (Cooper, 2011; Lukas and Maignan, 1996). Internal customers are important especially for companies operating in international markets, due to limited contact with external customers (Conduit and Mavondo, 2001).

Customers are important source for product development projects, and their input is critical to ensure product success (Alam, 2005; Cohen *et al.,* 2002; Griffin, 2005; Cooper, 2011). Customer input can reduce uncertainty and enable developing foresight to meet customers' future needs better (Un and Cuervo-Cazurra, 2009). Bidirectional communications and joint problem solving with customers enables understanding needs that are difficult to express and developing successful products (Bonner, 2010). However, companies operating in market-driven environment must find the right balance between market-pull and technology-push (Isoherranen and Kess, 2011; Rothwell, 1992). Furthermore, too close relationships with customers may restrict a company to respond to market changes (Sull, 1999).

In addition to immediate customers, expanded customer base and context where the product is used should be considered, as the whole supply chain adoption is a pre-requisite for new product success (Berggren and Nacher, 2001; Jones and Ritz, 1991). Describing expanded customer base and analysing the whole value chain provides understanding beyond direct customer, and may lead to value innovation (Donaldson *et al.,* 2006; Goodrich and Aiman-Smith, 2007; Kim and Mauborgne, 1997). Product end-users must be considered in all cases, but other types of customers and stakeholders may also need to be taken into account (Griffin, 2005; Ulrich and Eppinger, 2000). Customer selection matrix with different segments and type of customers, such as lead users close to the company, is proposed for

choosing the customers to focus on (Alam, 2005; Ulrich and Eppinger, 2000, von Hippel, 1986).

Acquiring useful knowledge from customers is challenging (Alam, 2005; Un *et al.,* 2010). The challenges in business-to-business (B2B) market include large number of parties in the relationship, such as initiators, users, influencers, deciders, buyers and gatekeepers (Kotler and Keller, 2009; Peppers and Rogers, 2011). Furthermore, downstream customers are often seen outside company's control and complicate, for instance, product development and marketing (Hillebrand and Biemans, 2011). Business-to-consumer (B2C) market challenges, in turn, include huge number of individual customers and understanding behaviours of different consumer groups (Kotler and Keller, 2009; Peppers and Rogers, 2011).

2. Product development and customer involvement

Product development transforms market opportunities into production, sale, and delivery of completely or partially new products (Krishnan and Ulrich, 2001; Ulrich and Eppinger, 2000). Product development projects can be classified into research and development (R&D) projects, breakthrough projects, platform projects, derivative projects, incremental improvements, and fundamentally new products (Schilling and Hill, 1998; Ulrich and Eppinger, 2000). Small change projects entail interacting with customers to acquire tacit knowledge about their needs and current product deficiencies. NPD to existing markets, in turn, requires translating customers' unmet tacit needs into product features without an existing product. In NPD to new markets, customer interaction typically takes place only when a prototype is available (Un and Cuervo-Cazurra, 2009).

In terms of customer engagement, product development can be categorised into design for, design with, and design by customers. In design for approach products are designed on behalf of customers, which also characterises market-driven product development (Fogelstrom *et al.,* 2010; Kaulio, 1998). Customer studies, such as interviews and focus groups, are typically utilised in this approach. In design with approach customers can additionally give feedback on the proposed design, whereas in design by approach customers actively participate in the design of their own product (Kaulio, 1998). Customers' role is also seen active in customer co-creation and open innovation (Chesbrough, 2003; Prahalad and Ramaswamy, 2004).

3. Conceptual framework

A company can have a number of external direct customers with different importance. Customer needs are affected by both internal and external stakeholders in the customer organisation. Direct customers may also have customers that can be final customers or intermediaries. Figure 1 illustrates customer definition and representation from product management and development perspective.

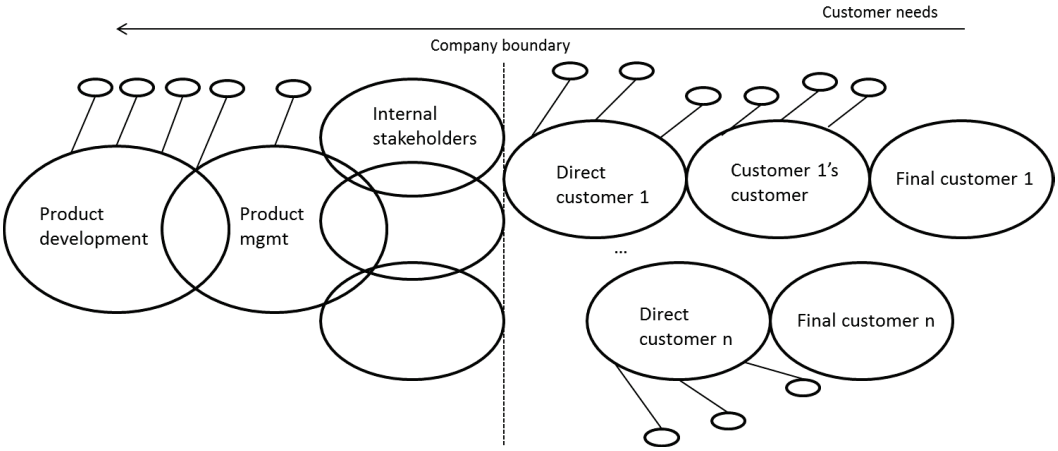


Figure 1. Customer definition and representation from product management and development perspective

Some customers are represented by the company's internal stakeholders, whereas other customers and their needs must be identified by other means. Product management and product development have to take into account many type of customers with different needs. Product management is assumed to have a major role in customer definition and internal collaboration with customer facing functions. In addition, successful requirement engineering is needed to transfer the right requirements, and thus enable creation of products that meet customer needs.

METHOD

The empirical part of the paper is based on two case projects including insights from interviews with mid-level managers. The managers represented both product management and development, and a total of 11 professionals were interviewed (Table 1). The companies were chosen from ICT industry, and one is in B2C and the other in B2B market.

Table 1. List of interviewees in the case projects

Case	Interviewee	Role	Industry experience
A	1	Product management	+10 years
	2	Concept management	+10 years
	3	Product management	+15 years
	4	Software product owner	+10 years
	5	Programme management	+15 years
	6	Project management	+10 years
B	1	Head of product management	+20 years
	2	Product management	+20 years
	3	Product management	+25 years
	4	Technical solution management	+25 years

Case	Interviewee	Role	Industry experience
	5	Platform system design management	+20 years

A semi-structured interview process was used to gain insights of the cases and respondents' thoughts regarding the issues studied. Interview questions are presented in Appendix A. The interviews typically lasted around one hour, and they were recorded and transcribed for analysis. The interview questions were designed to gain each manager's perspective on customer definition and representation in product development. The interviews started with general questions, but included also specific follow-up questions to elaborate on company- and project-specific issues.

The data were analysed using a qualitative approach of reading the interviews several times, each time going deeper into the data to discover connections, patterns, and comparisons. Emerging patterns were structured into more generic categories that helped refine the conceptual framework and define the key concepts. Based on the categorisation of individual cases, a cross-case analysis was performed to find patterns, similarities, and differences between the cases.

EMPIRICAL SURVEYS

1. Case A

Case A is a software project of large ICT company that operates in a global B2C market. The project entailed a software release programme starting from concept development and ending to launch. In addition, the architecture of the software platform used in the final products was renewed. The final products were targeted to specific consumer group, but also wider market, distribution partners, and geographical requirements were taken into account. In contrast to earlier projects in the company, the product definition was started from scratch, and only a core set of features was defined for sales start. In addition, way of working in product development was renewed. This included, for example, specifying testing of new features already in their definition phase, and changing requirement and error database structures to support the new mode of operation. The project can be classified as a market-driven product development project with large number of customers to be served. In terms of size and newness, it was considered a large-scale, radical project. The development model used in the company was based on agile principles.

2. Case B

Case B is hardware and embedded software project of large ICT company that operates in a global B2B market. The project entailed development of new product platform to replace the current solution in the market. The platform is used by the company's business lines, which productise final products to external customers. The final products were focused on selected key customers, but also wider market including different technical and geographical requirements were considered. The product was very complex, and thus the development time was relatively long. The project can be classified as a market-driven product

development project with large number of customers to be served. The project represented a typical platform development project in the company, although it was somewhat larger than usual projects in the organisation. The development model was based on concurrent engineering for hardware components and agile principles for software parts.

3. Project key stakeholders and customer definition

3.1 Case A

In case A, various stakeholders were identified for the project, and interviewees presented many viewpoints for customer definition. Figure 2 illustrates the customer definition in case A.

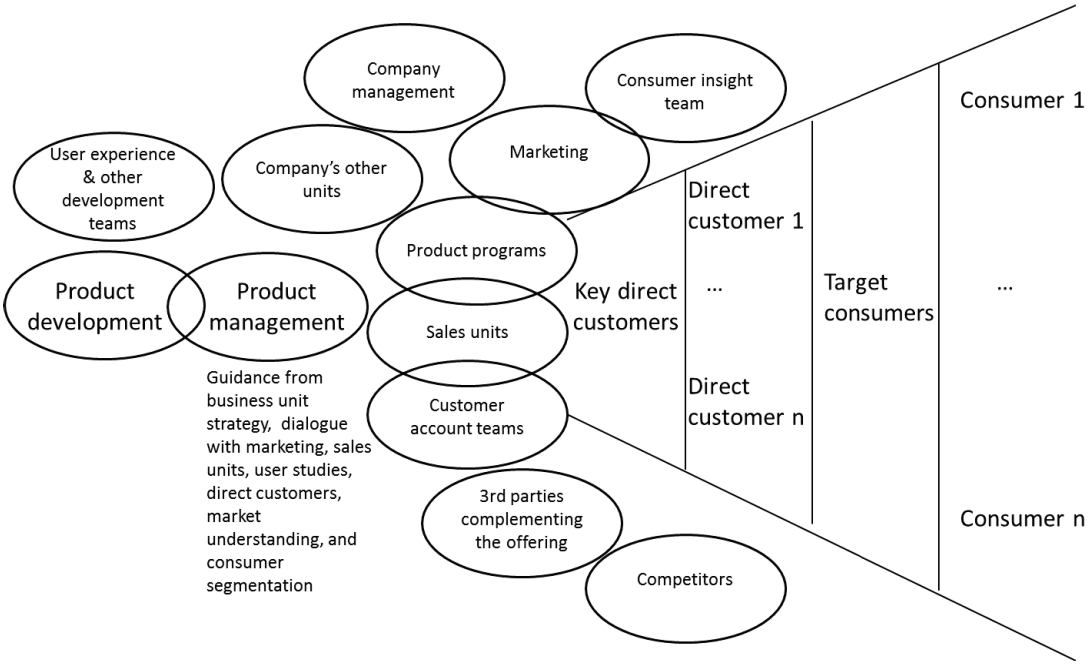


Figure 2. Customer definition from product management and development perspective in case A

Product management representatives saw that key external stakeholders in the project included consumers (product end-users), distribution partners (direct customers), and competitors. In addition, one interviewee pointed out external innovation partners. Regarding internal stakeholders, the research and development (R&D) organisation, sales units, customer account teams, and product programmes using the software were classified as key partners. Marketing and other internal sources for consumer data and competitor information were also seen important. In addition, other company units, such as another business unit and long-term research unit were categorised as key stakeholders.

Representatives from product management highlighted many ways for defining customers. Dialogues with marketing, sales units and regions were considered to be important, and business unit strategy was also seen to provide guidance for customer definition. In addition, the largest direct customers were considered to be important in the customer definition. However, consumers were clearly described to be the most important customer group, and

the definition of consumer customer was assisted by collecting and analysing user databases and studies. Furthermore, company-wide market understanding and consumer segmentation were seen beneficial.

From product development representatives' perspective, key external stakeholders included direct customers, consumers, and 3rd party application developers. Key internal stakeholders, in turn, included product management, product programme using the software, sales units and regions, marketing and the internal organisation dealing with 3rd party application developers. In addition, development teams in different sites, user experience team, and company management were considered as key stakeholders.

Product development representatives saw that customer definition came from product management, marketing, and consumer insight teams. In addition, the management team of the product programme utilising the software, and especially its product manager were considered to be involved in customer definition. Interviewees also mentioned also a "theme person" that illustrated a target consumer, but it was unclear for them who created that theme person.

3.2 Case B

In case B, fewer project stakeholders were identified than in case A, and customer definition was also seen differently. Figure 3 illustrates the customer definition in case B.

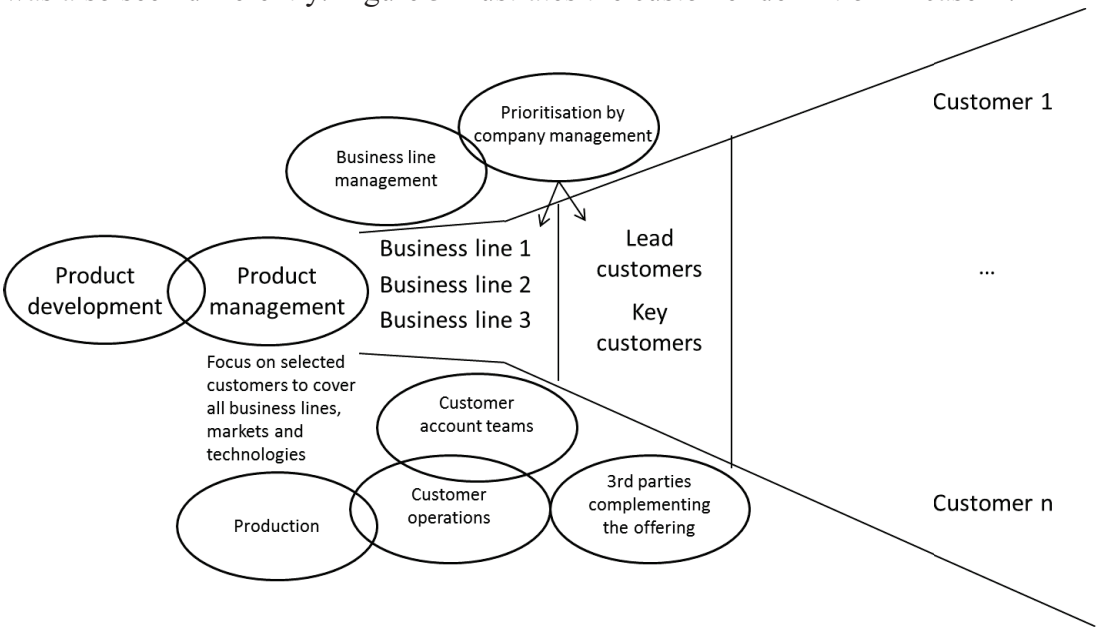


Figure 3. Customer definition from product management and development perspective in case B

For product management representatives, the most important external stakeholders in the project included direct customers and 3rd parties complementing the company's offering. Key internal stakeholders, in turn, were considered to be business lines that funded the development, research and development (R&D) organisation, customer account teams, management, operations taking care of customer installations, and production.

Product management representatives' customer definition included both internal and external customers. The company had three business lines that were considered to be internal customers, and the business lines were prioritised based on sales volumes and growth potential. The company's external customer base consisted of hundreds of direct customers. The company had defined priority markets, and the most important customers were classified as key and lead customers. Customer prioritisation was done by the company management. However, product management representatives saw that there were still too many focus areas, and the priorities were not clear. To ensure sufficient customer understanding, product management had selected 20 customers from the lead customer group for direct connections. In addition to sales volumes, the selection criteria aimed to cover different types of customers, all three business lines, and various geographical and technical aspects.

Product development representatives saw direct customers to be key external stakeholders in the project. Key internal stakeholders, in turn, included product management, business lines, business line management, and portfolio management that facilitated decision making regarding technology choices. Customer prioritisation was acknowledged, but customers' short-term and narrow focuses were considered as challenges from platform development point of view. Regarding internal customers, a lead business line, which might not have the highest business priority but productises the platform first, was also considered important.

4. Customer representation in development

4.1 Case A

In addition to customer definition, the representation of customers was also analysed. Figure 4 illustrates customer representation in case A.

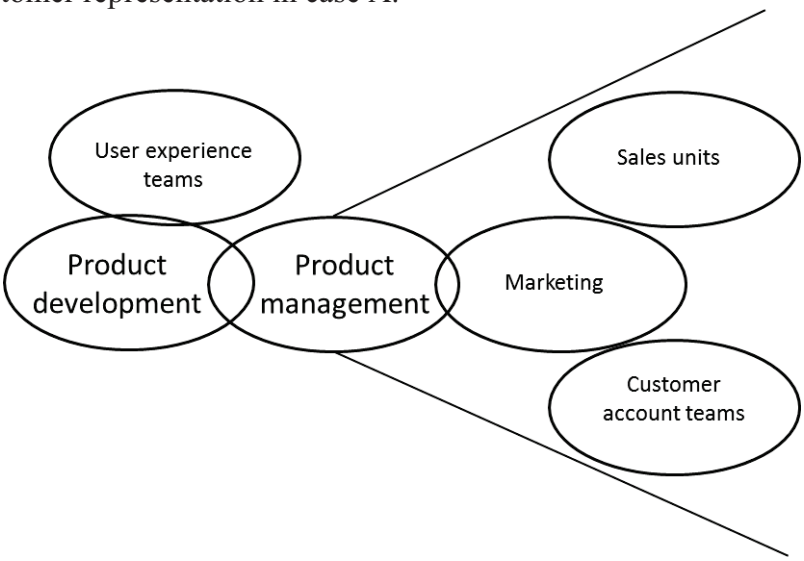


Figure 4. Customer representation from product management and development perspective in case A

Product management representatives saw that product management represents customers for product development. Customer voice to product management, in turn, was seen to come from sales units, customer account teams and other regional contacts, and marketing. In addition, user databases and market surveys were seen as important information sources for

product management to gain necessary knowledge for representing the customers in development.

Product development representatives also considered product management to represent customers, and product management was expected to collaborate with relevant stakeholders to acquire necessary information from the customers. On the other hand, user experience teams were also seen to represent consumer (end-user) view during development, since these teams possessed understanding of detailed product functionalities from usability perspective. In addition, end-user research, analyses, testing, market data, and error databases provided customer related information during development. Finally, in this particular project, requirement database and existing products were checked to identify critical customer features, and these were discussed iteratively with stakeholders close to external customers. Contrary to the previous projects, only a core set of features was defined for sales start.

4.2 Case B

Customer representation was also analysed in case B. Figure 5 illustrates the customer representatives in case B.

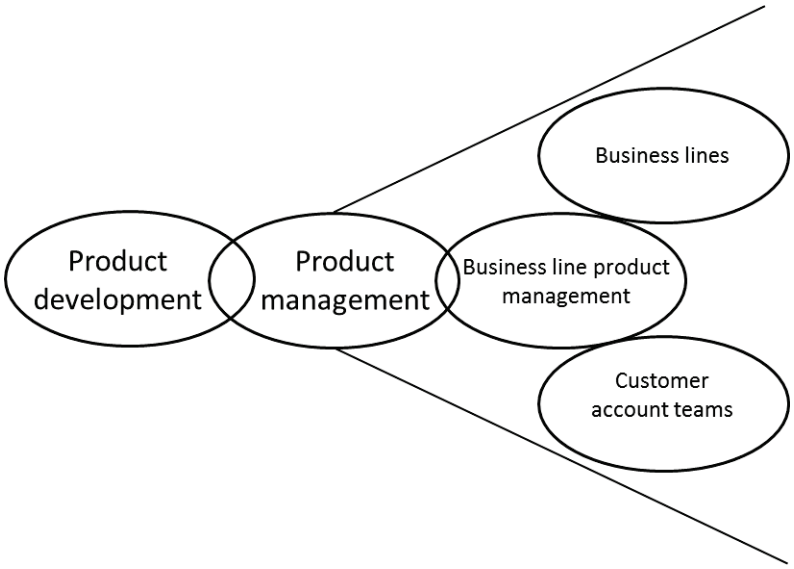


Figure 5. Customer representation from product management and development perspective in case B

As in case A, product management representatives saw that product management represents customers for product development. The customer representatives from product management's perspective consisted of business lines, their product managers, and key customer account teams in contact with direct customers. Tools for customer representation and providing feedback included databases and the relevant contacts in the organisation. In addition to meetings at customers' facilities, key customers also visited the company to discuss special topics directly with product management. Market reports were also used to some extent. Internal customer representation was ensured with business lines' participation in the project organisation. Downstream customers (direct customers' customers) were considered only little, since the direct customers were seen to represent their views anyway.

Product development representatives also confirmed that product management represents customers. This was considered a good arrangement, although it was pointed out that product management has a "challenge to interpret things that customer do not know they want." Discussions, presentations, and excel files were used for communicating customer views, before entering requirements into relevant tools. Regarding internal customer representation, technical management and concept teams with representation from business lines were mentioned.

5. Other findings

5.1 Case A

In case A, product management representatives highlighted the need for technology-push and market-pull balance, since both were considered important. The importance of systematically gathering and using customer related information was also emphasised. User understanding, finalisation of product and features, and differentiation in product implementation were considered important, since similar market data was also available for competitors. In addition, distributing consumer and target group understanding through organisation was considered important. Sufficient face-to-face involvement with end-users was seen lacking currently.

Representatives from product development emphasised that unnecessary handovers between product management and development must be avoided in project definition. Furthermore, testing and verification should be taken into account already in the definition phase. In addition, especially people developing features were considered to benefit from seeing how end-customers use the product. However, this was realised to be too expensive in practice. Individual developers were also recommended to use the products and features they are developing to gain a user perspective.

5.2 Case B

In case B, product management representatives emphasised that customer contacts are extremely important. Talking to key customers also directly was seen as a good practice. Account teams' and customers' views were seen to differ sometimes, since the account teams focus on selling the current products. Furthermore, unclear responsibilities, getting the needed internal commitment and organisation changes were seen as challenges, since internal customers might change during the project. "Gut feeling" in product definition was considered important, since customers were seen to be uncertain on their long-term needs. Involving internal stakeholders early as possible was also recommended, and especially good co-operation between product development and product management was seen critical.

From product development representatives' perspective, understanding customers and deciding how to optimise the product, was considered a challenge. From platform development perspective, better prioritisation in decision making was desired. Time-wise, both external and internal customers' focus was seen different from product development. However, it was pointed out that both current customer issues and long-term needs must be considered.

DISCUSSION

This study indicates that customer definition and representation in market-driven product development is not unambiguous. Product management plays a key role both in customer definition and representation, and must effectively co-operate with many stakeholders to ensure a product that meets customer and market needs while providing business sustainability. Product management must understand the overall picture and has responsibility of the right balance and product priorities, both from customer and business perspective. However, product development cannot transfer the responsibility of customer understanding solely to product management. The right product design involves deciding a large amount of details. In addition, seamless cooperation between product management is required. For example, in case A avoiding handovers between product management and product development in project definition was considered a good practice.

1. Theoretical implications

Literature discusses the importance of customers for product development and presents various definitions of customers (Alam, 2005; Cohen *et al.,* 2002; Cooper, 2011; Griffin, 2005; Peppers and Rogers, 2011). However, customers cannot directly participate in actual development when structural product development processes are used. Furthermore, in market-driven context products are typically offered to a large customer base, which significantly complicates customer definition and representation. The literature review and cases analysed in this study provide new viewpoints on the ways customers are defined and represented by product management and development managers.

The role of product management has been discussed in the literature (e.g. Maglyas *et al.,* 2012). The results of this study indicate that product management plays a key role in customer definition and representation. In addition, co-operations with many internal stakeholders were emphasised in the cases. This is in line with inter-functional coordination (Narver and Slater, 1990) and the role of internal customers (Conduit and Mavondo, 2001), which have been considered important in the context where the case companies operate. The study also illustrates the differences between business-to-consumer and business-to-business markets. In case A, end-users were seen to be more important than direct customers. On the other hand, in case B, downstream customers were considered only little (Hillebrand and Biemans, 2011). Finally, the research is in line with Fogelstrom *et al.* (2010) by supporting the importance of market-pull and technology-push balance.

2. Managerial implications

Creating a successful product requires that target customers are clearly defined. This study indicates that the role of product management is essential in market-driven product development; companies must therefore ensure that product management teams are appropriately resources and competent. Company and business unit strategy should provide proper guidance to ensure that focus and priorities are clear. In addition, product management must collaborate with various stakeholders including marketing, sales, and management in customer definition.

The study results highlighted the importance of internal customers and inter-functional coordination. Managers should target systematic way of working and good co-operation among internal stakeholders to ensure that customer views are taken into account. Forming customer definition should be seen as a dialogue between product management and stakeholders close to the customers. On the other hand, effective co-operation between product management and product development is vitally important too.

Whereas product management is the most important customer representative towards product development, other useful information sources also exist for product development to gain customer understanding for the design decisions. Documentation's role is important, since customer information flows via several stakeholders. Besides internal inputs, product management and development professionals should aim for direct contact with external customers, since proper customer understanding results in better decisions and tackles problems related to conflicting internal views. While focus on selected customers is important, the whole value chain must be considered to create a product that meets market needs.

CONCLUSIONS

The significance of customers as key product developments stakeholders is evident. However, increasingly complex global markets pose challenges for companies to fulfil the market needs. This applies especially when products are offered to a large number of customers instead of a sole one deciding the functionality. The validity of customer information that flows via various stakeholders is also a challenge. This study explores customer definition and representation in market-driven product development.

The results indicate that customer definition in market-driven product development is not unambiguous. Company management and strategy must guide customer definition. Product management plays a key role in defining customers, and companies must therefore ensure that appropriate resources and competences exist within product management teams. Effective co-operation should be targeted among product management and internal stakeholders. Product management was found to be the most important customer representative towards product development. However, product development must also gain customer understanding to ensure the right design decisions. In addition, facing external customers sometimes directly is recommended for both product management and product development professionals.

The limitations of this study include the number of case projects being only two. Recommended future study includes how well the study findings apply to different types of companies and industries. In addition, customer need identification and methods used should be analysed. Finally, prioritisation of unique needs and the relationships between requirements and stakeholders deserve attention.

ACKNOWLEDGEMENTS

The authors express their gratitude to the interviewees in the case companies for their valuable inputs.

REFERENCES

1. Alam, I. (2005), "Interacting with customers in the new product development process" in Kahn, K.B. (Ed.), *The PDMA handbook of new product development*, 2nd edn., John Wiley & Sons, Inc., New Jersey, pp. 249-262.
2. Berggren, E. and Nacher, T. (2001), "Introducing new products can be hazardous to your company: Use the right new-solutions delivery tools", *Academy of Management Executive*, Vol. 15, No. 3, pp. 92-101.
3. Bonner, J.M. (2010), "Customer interactivity and new product performance: Moderating effects of product newness and product embeddedness", *Industrial Marketing Management*, Vol. 39, No. 3, pp. 485-492.
4. Caplan, F. (2001), "What Is a Customer?", *Quality Engineering*, Vol. 14, No. 2, pp. ix-x.
5. Chesbrough, H.W. (2003), *Open innovation: the new imperative for creating and profiting from technology*, Harvard Business School Publishing Corporation, USA.
6. Christ, P. (2009), *KnowThis: Marketing Basics,* KnowThis Media.
7. Cohen, W.M., Nelson, R.R. and Walsh, J.P. (2002), "Links and impacts: The influence of public research on industrial R&D", *Management Science*, Vol. 48, No. 1, pp. 1-23.
8. Conduit, J. and Mavondo, F.T. (2001), "How critical is internal customer orientation to market orientation?", *Journal of Business Research*, Vol. 51, No. 1, pp. 11-24.
9. Cooper, R.G. (2011), *Winning at new products: Creating value through innovation*, 4th edn.., Basic Books, USA.
10. Donaldson, K.M., Ishii, K. and Sheppard, S.D. (2006), "Customer value chain analysis", *Research in Engineering Design*, Vol. 16, No. 4, pp. 174-183.
11. Fogelstrom, N.D., Gorschek, T., Svahnberg, M. and Olsson, P. (2010), "The impact of agile principles on market-driven software product development", *Journal of Software Maintenance and Evolution*, Vol. 22, No. 1, pp. 53-80.
12. Goodrich, N. and Aiman-Smith, L. (2007), "What does your most important customer want?", *Research Technology Management*, Vol. 50, No. 2, pp. 26-35.
13. Gorschek, T., Gomes, A., Pettersson, A. & Torkar, R. (2012), 'Introduction of a process maturity model for market-driven product management and requirements engineering', *Journal of software: Evolution and Process*, vol. 24, no. 1, pp. 83-113.
14. Griffin, A. (2005), "Obtaining customer needs for product development" in Kahn, K.B. (Ed.), *The PDMA handbook of new product development*, 2nd edn., John Wiley & Sons, Inc., New Jersey, pp. 211-227.
15. Hillebrand, B. and Biemans, W.G. (2011), "Dealing with downstream customers: An exploratory study", *Journal of Business and Industrial Marketing*, Vol. 26, No. 2, pp. 72-80.
16. Isoherranen, V. and Kess, P. (2011), "Strategy Orientation Analysis in the Mobile Phone Case Business", *Modern Economy*, Vol. 2, pp. 395-402.
17. Jones, J.M. and Ritz, C.J. (1991), "Incorporating distribution into new product diffusion models", *International Journal of Research in Marketing*, Vol. 8, No. 2, pp. 91-112.
18. Kaulio, M.A. (1998), "Customer, consumer and user involvement in product development: A framework and a review of selected methods", *Total Quality Management*, Vol. 9, No. 1, pp. 141-149.
19. Kauppinen, M., Vartiainen, M., Kontio, J., Kujala, S. and Sulonen, R. (2004), 'Implementing requirements engineering processes throughout organizations: Success factors and challenges', *Information and Software Technology*, Vol. 46, No. 14, pp. 937-953.

20. Kim, W.C. and Mauborgne, R. (1997), "Value innovation: the strategic logic of high growth", *Harvard business review*, Vol. 75, No. 1, pp. 102-112.
21. Kotler, P. and Keller, K.L. (2009), *Marketing management*, 13th edn., Pearson Prentice Hall, USA.
22. Krishnan, V. and Ulrich, K. (2001), "Product development decisions: a review of the literature", *Management Science*, Vol. 47, No. 1 (January), pp. 1-21.
23. Lehmann, D.R. and Winer, R.S. (2002), *Product management*, 3rd edn., McGraw-Hill, New York.
24. Lukas, B.A. and Maignan, I. (1996), "Striving for quality: The key role of internal and external customers", *Journal of Market-Focused Management*, Vol. 1, No. 2.
25. Maglyas, A., Nikula, U. and Smolander, K. (2012), '*What do practitioners mean when they talk about product management?*', 20th IEEE International Requirements Engineering Conference, RE 2012 - Proceedings, pp. 261-266.
26. Mottonen, M., Belt, P., Harkonen, J. and Lin, B. (2009), "Managing requirements in ICT companies", *Business Process Management Journal,* Vol. 15, No. 6, pp. 968-989.
27. Mottonen, M., Harkonen, J., Belt, P., Haapasalo, H. and Simila, J. (2009), "Managerial view on design for manufacturing ", *Industrial Management and Data Systems,* Vol. 109, No. 6, pp. 859-872.
28. Narver, J.C. and Slater, S.F. (1990) "The effect of a market orientation on business profitability", *Journal of Marketing*, Vol. 54, October, pp. 20-35.
29. Peppers, D. and Rogers, M. (2011), *Managing customer relationships: A strategic framework*, 2nd edn., John Wiley & Sons, Inc., New Jersey.
30. Prahalad, C.K. and Ramaswamy, V. (2004), *The future of competition: co-creating unique value with customers*, Harvard Business School Publishing, USA.
31. Rothwell, R. (1992), "Successful industrial innovation: critical factors for the 1990s", *R&D Management*, Vol. 22 No. 3, pp. 221-240.
32. Schilling, M.A. and Hill, C.W.L. (1998), "Managing the new product development process: Strategic imperatives", *IEEE Engineering Management Review*, Vol. 26, No. 4, pp. 55-68.
33. Sommerville, I. (2005) 'Integrated requirements engineering: A tutorial', *IEEE Software*, Vol. 22, No. 1, pp. 16-23.
34. Sull, D.N. (1999), "Why good companies go bad ", *Harvard Business Review*, July-August.
35. Ulrich, K. and Eppinger, S.D. (2000), *Product design and development*, 2nd edn.., McGraw Hill, Singapore.
36. Un, C.A. and Cuervo-Cazurra, A. (2009), "Interactions with customers for innovation" in Costanzo, L.A. and MacKay, R.B. (Eds.), *Handbook of Research on Strategy and Foresight*, Edward Elgar Publishing Limited, Northampton, MA, pp. 362-279.
37. Un, C.A., Cuervo-Cazurra, A. and Asakawa, K. (2010), "R&D collaborations and product innovation", *Journal of Product Innovation Management*, Vol. 27, No. 5, pp. 673-689.
38. von Hippel, E. (1986), "Lead Users: a Source of Novel Product Concepts", *Management Science*, Vol. 32, No. 7, pp. 791-805.

APPENDIX

Appendix 1. Interview questions

Background
Tell about your current role and position, and previous experience
What is your company's offering?
- What do you sell, to whom and with whom you co-operate to provide the offering?

What is the role of product development in your company?
- What is your opinion of the right balance between technology-push and market-pull?
- How important is it to consider customer and market needs in development?

About the project
Tell briefly about the case project and your role in it
- Was the development customer-led, collaborative with customer, or market-driven (large number of customers to be considered)?
- Was the project typical full-scale product development project or radical project?
- Was the product development model type waterfall, concurrent, or agile?

About the stakeholders and customers
Who were the external and internal stakeholders in the project?
- Especially, who were the most important stakeholders and customers?
- How do you understand term "customer"?
- Who were the internal customers in your company?

How did you identify the most important customers?
- Who defined the customers?
- Did you use any systematic methods to identify the customers?
- What were the good practices and key challenges?

Who represented the customers in development?
About identifying customer needs (the results not included in this paper)
How did you identify the customer needs?
- Did you collaborate with customers? With whom and how?
- Did you use any systematic methods?
- What were the good practices and key challenges?

Did you utilise the following methods?
- Surveys, interviews, observation, web sites, focus groups, customer discussions and workshops, identifying lead users, becoming a user, customer integration into product development team
- With whom did you use the methods?

Final comments
Do you have any other comments related to this topic?

BIOGRAPHICAL

Jukka Majava works as Doctoral Student in the Department of Industrial Engineering and Management at the University of Oulu. He has research interest in product development, business networks, and supply chain development. His industrial experience includes technology marketing, partner management, project management, and supply chain development at Nokia Corporation.

Jouko Nuottila works as Project Researcher in the Department of Industrial Engineering and Management at the University of Oulu, and his research topic is flexible contracting. He has industrial experience in technology marketing, software product management, and technical support at Nokia Corporation.

Dr. Harri Haapasalo is Dean for Research, Faculty of Technology, and Professor of Technology Management in the Department of Industrial Engineering and Management at the University of Oulu. He has a D.Sc. in Technology Management and a Master's degree in Economics and Business Administration, both from the University of Oulu, Finland. He has research interests in planning, product development, and technology commercialisation. He has authored almost 200 international scientific articles.

Dr. Kris Law obtained her PhD in the field of organisational learning and development, and is currently Lecturer at the Hong Kong Polytechnic University. Prior to this, she obtained a post-doctoral research scholarship for a high-tech supply chain study at the National Taiwan University. Dr. Law has been involved in various research projects in high-tech management and technology management. She has worked on numerous research projects in Pearl River Delta, Taiwan, Thailand, and Europe relating to high-tech entrepreneurship and technological innovation.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

WHY CONSUMERS RESIST MOBILE PAYMENT? A CONCEPTUAL MODEL

Aik-Chuan Teo, Universiti Tunku Abdul Rahman, Malaysia,
Faculty of Business and Finance
teoac@utar.edu.my

Ching-Mun Cheah, Universiti Tunku Abdul Rahman, Malaysia,
Faculty of Business and Finance
cheahcm@utar.edu.my

Keng-Boon Ooi, Linton University College, Malaysia, Chancellery Division
ooikengboon@gmail.com

Jessica C.J. Wong, Linton University College, Malaysia, Chancellery Division
jessicawcj@gmail.com

ABSTRACT

The fast pace of wireless networks and mobile technologies development has created vast opportunities for financial service providers to render their services via the mobile platform. However, the acceptance of financial mobile services, particularly the mobile payment is still marginally adopted. While most of the research efforts focus on the positive determinants that influence such innovation, however, little attention has been given to understand why Malaysian consumers resist mobile payment services. Acknowledging that mobile payment still meet consumer resistance, this paper aims to examine the barriers that may inhibit the adoption of mobile payment. The study provides a thorough understanding for the service providers to overcome the resistance of mobile payment service.

Keywords: Mobile Payment, Innovation Resistance, Adoption Barriers, Malaysia

INTRODUCTION

M-payment refers to making payment for goods, services, and bills via mobile phone using wireless technology (Dahlberg et al., 2008). Acknowledging the high penetration rate of mobile devices, Yang et al. (2012) foresee mobile payments as important platform for performing financial transactions and also known as the most significant drivers for successful future of m-commerce. As a matter of fact, Juniper research (2010) reported that the worldwide payment values via mobile devices would reach $630 billion in 2014. Thus, it is not surprising that many companies have substantially invested in rendering m-payment services with the aims of higher profits.

A review of the extant literature of m-payment shows that many studies mainly focused on the driving factors of adoption (Yang et al., 2012; Kim et al., 2010; Mallat, 2007). Meanwhile, Sheth (1981) commented that the innovation research suffered from pro-change bias presuming that every innovation is good and should be used by every consumer. In fact, several researches asserted that many innovations are still likely to meet consumers'

resistance (Garcia & Atkin, 2002; Molesworth & Suortti, 2002). In the m-payment context, several researchers found that the adoption is still marginally adopted (Chandra et al., 2010; Dahlberg et al., 2008; Mallat and Tuunainen, 2008). Despite the low adoption of m-payment, the scholar further commented that the reality looks quite different and the circumstance often de-motivate m-payment service providers in rendering the m-payment service (Schierz et al., 2010). The scenario has led to the question as to why consumers resist m-payment.

Hence, this conceptual paper adopts the Theory of Innovation Resistance (Ram & Sheth, 1989) to understand why consumers resist mobile payment services. The conceptual paper begins with the introduction, followed by the review of literatures, proposed research model and hypothesis development. Lastly, the paper ends with the conclusion and implications of the study.

LITERATURE REVIEW

Theory of Innovation Resistance

The main cause of innovation failure is the consumer resistance (Ram & Sheth 1989). Acknowledging that consumers' resistance to innovations has received relatively little from research attention (Szmigin & Foxall, 1998), the theory of innovation resistance plays an important role to explain why users resist innovations. Based on the theory, Ram & Sheth (1989) suggested two barriers to innovation adoption, namely functional and psychological barriers. The functional barriers consisting of usage barriers, value barriers, and risk barriers, whilst, the psychological barriers consisting of tradition barriers and image barriers.

Theory of Innovation Resistance

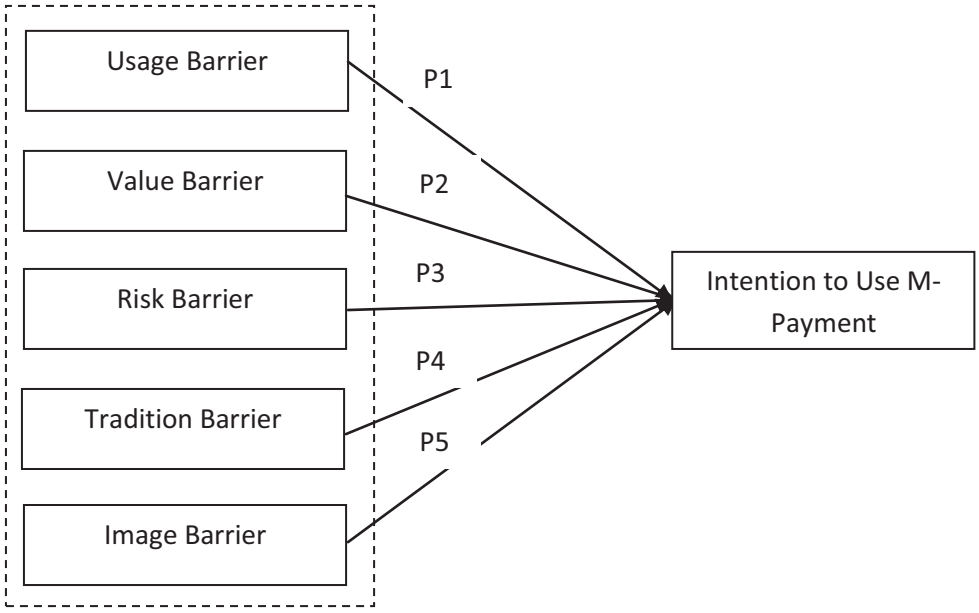


Figure 1: Conceptual Research Framework

HYPOTHESIS DEVELOPMENT

Usage barrier occurs when an innovation is not in lines with user's current workflows, practices and habits which generally lead to consumer innovation resistance (Ram and Sheth, 1989; Sheth and Ram, 1987). In the context of m-payment, compatibility signifies one's ability to integrate the service with their existing behavioral patterns (Lee et al., 2003). In view of slow data transmission and user interface, Laukkanen and Lauronen (2005) commented that making payment through mobile phone is too complex and time consuming. Value barrier, according to Ram and Sheth (1987) refers to performance-to-price value. Compared to alternative solutions, this simply implies that if m-payment services does not offer a strong performance-to-price compared to conventional payment method such as cash and credit card, consumers may not feel motivated to adopt the service. Mallat (2007) also illustrated that the users resist of mobile payment because of its 'premium pricing' The additional charges may be incurred from mobile payment compared to payment by cash. Acknowledging uncertainty inherent in innovations, innovations often lead to certain level of perceived risk (Ram and Sheth, 1989). In view of the wireless setting, the fear of security breaches, identity theft and passive confidentiality are often discouraging users from using the service (Zhou, 2011). "The more risk adverse a subject is, the lower its acceptance and longer the diffusion will take" (Dunphy &Herbig, 1995, pp.203). Tradition barrier simply implies that the change an innovation may affect one's routines. In another words, the high tradition barrier will exist when the innovation is contrary to one's societal, social norms, and family values (Ram & Sheth, 1987; Ram & Sheth, 1989). Fain & Roberts (1997) further illustrated that the tradition barrier will occur when performing financial activities through electronic modes are contrary to the way uses used to pay bills. This is particularly true when users opt to have interaction in their payment transaction. Each innovation attains a certain identity from its origins (i.e., product category, country of origin, and the brand). The image barrier comes into place when one's has stereotyped thinking of internet and m-payment services. Thus, we postulated the following propositions:

P1: Usage barrier has significant impact towards use of m-payment.
P2: Value barrier has significant impact towards use of m-payment.
P3: Risk barrier has significant impact towards use of m-payment.
P4: Tradition barrier has significant impact towards use of m-payment.
P5: Image barrier has significant impact towards use of m-payment.

CONCLUSION AND IMPLICATIONS

In sum, the conceptual paper focused on the barriers that inhibit m-payment in Malaysia. Whilst most of the IS studies have concentrated on the reasons for promoting adoption, innovation resistance has been neglected in IS research. Hence, the conceptual paper bridge the gap by adopting the 5 constructs of Theory of Innovation Resistance by Ram and Sheth (1989), specifically usage barrier, value barrier, risk barrier, tradition barrier and image barrier to understand what inhibits the adoption of m-payment in Malaysia. As high investment involved in developing m-payment infrastructures, therefore, it is crucial to assure that the targeted users are essentially use the service. Hence, the paper also provides companies a bigger picture of the rationale in resistance of m-payment services. This enables companies to formulate wining strategies to yield higher level of m-payment acceptance.

REFERENCES

1. Chandra, S., Srivastava, S. C., and Theng, Y. L. (2010), "Evaluating the role of trust in consumer adoption of mobile payment systems: an empirical analysis", *Communications of the Association for Information Systems*, Vol. 27 No. 1, pp. 561-588.
2. Dahlberg, T., Mallat, N., Ondrus, J., and Zmijewska, A. (Summer, 2008), "Past, present and future of mobile payments research: a literature review", *Electronic Commerce Research and Applications*, Vol. 7 No. 2, pp. 165-181.
3. Dunphy, S., and Herbig, P. A. (1995), "Acceptance of innovations: the customer is the key!", *The Journal of High Technology Management Research*, Vol. 6 No. 2, pp. 193-209.
4. Fain, D., and Roberts, M. L. (1997), "Technology vs. consumer behaviour: the battle for the financial services customer", *Journal of Direct Marketing*, Vol. 11 No.1, pp. 44-54.
5. Garcia, R., and Atkin, T. (2005), "Coo-petition for the diffusion of resistant innovations: a case study in the global wine industry", *Northeastern University Institute for Global Innovation Management Working Paper 05 – 002,* Institute for Global Innovation Management, Northeastern University, Boston.
6. Juniper Research (2008), "Global m-commerce revenue projections for 2009", *ePaynews.com Website*, available at: http://www.paynews.com/stastistics/mcommstats.html [accessed 12 April 2013].
7. Kim, C., Mirusmonov, M., and Lee, I. (2010), "An empirical examination of factors influencing the intention to use mobile payment", *Computers in Human Behavior*, Vol. 26, pp. 310-322.
8. Ram, S., and Sheth, J. N. (1989), "Consumer resistance to innovations: the marketing problem and its solutions", *Journal of Consumer Marketing*, Vol. 6 No. 2, pp.5 – 14.
9. Laukkanen, T., and Lauronen, J. (2005), "Consumer value creation in mobile banking services", *International Journal of Mobile Communications*, Vol. 3 No. 4, pp. 325-338.
10. Lee, M. S. Y., McGoldrock, P. J., Keeling, K. A., and Doherty, J. (2003), "Using ZMET to explore barriers to the adoption of 3G mobile banking services", *International Journal of Retail & Distribution Management*, Vol. 31 No. 6, pp. 340-348.
11. Mallat, N. (2007), "Exploring consumer adoption of mobile payments – a qualitative study", *Journal of Strategic Information Systems*, Vol. 16 No. 4, pp. 413-432.
12. Mallat, N., and Tuunainen, V. K. (2008), "Exploring merchant adoption of mobile payment systems: an empirical study", *e-Service Journal*, Vol. 6 No. 2, pp. 24 – 57.
13. Molesworth, M., and Suortti, J. P. (2002), "Buying cars online: the adoption of the web for high-involvement, high-cost purchases", *Journal of Consumer Behaviour*, Vol. *2* No. 2, pp. 155-168.
14. Schierz, P. G., Schilke, O., and Wirtz, B. W. (2010), "Understanding consumer acceptance of mobile payment services: an empirical analysis", *Electronic Commerce Research and Applications*, Vol. 9, pp.209-216.
15. Sheth, J. N., and Ram, S. (1987), "Bringing innovation to market: how to break corporate and customer barriers", *Wiley*.
16. Szmigin, I., and Foxall, G. (1998), "Three forms of innovation resistance: the case of retail payment methods", *Technovation*, Vol. 18 No. 6, pp. 459-468.
17. Yang, S., Lu, Y., Gupta, S., Cao, Y., and Zhang, R. (2012), "Mobile payment services adoption across time: an empirical study of the effects of behavioral beliefs, social influences, and personal traits", *Computers in Human Behavior*, Vol. 28 No. 1, pp. 129-142.

18. Zhou, T., Lu, Y., and Wang, B. (2010), "Integrating TTF and UTAUT to explain mobile banking user adoption", *Computers in Human Behavior*, Vol. 26 No. 4, pp. 760-767.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE IMPACT OF TRUST AND STEREOTYPES ON THE TYPE OF DOCTOR – PATIENT RELATIONSHIP A STUDY ON POLISH HEALTH CARE MARKET

Dr Katarzyna Krot, Bialystok University of Technology, Management Department, 16-001 Kleosin,Poland
katarzynakrot@gmail.com

ABSTRACT

Purpose: *The doctor-patient relationship is a crucial element of healthcare. Literature distinguishes between four models of the doctor-patient relationship: paternalistic, shared decision making, interpretative and informed choice. Socio-economic transformations also alter the nature of this relationship. Therefore, the aim of this paper was to investigate the model of doctor-patient relationship and to identify the determinants of this relation.*
Methodology: *The study was carried out in the form on a sample of 208 students in the Podlasie Region.*
Findings: *The model of a doctor-patient relationship preferred by respondents was determined by stereotypes associated with the size of the city where medical services were provided and the gender of the physician, as well as the level of trust for the competence and integrity of the doctor.*
Originality: *Many authors emphasize that the paternalistic relationship is being replaced by the more balanced contacts between the physician and the patient. The study results show, however, that this is not so definite. Many patients still prefer to submit to the authority of the doctor (paternalistic relationship)*

Key words: model of doctor-patient relationship, trust, stereotypes

INTRODUCTION

Medical services are characterized by a high level of uncertainty and risk. Patients lack professional knowledge which would allow them to assess the quality of services obtained (Berry and Bendapudi, 2007). For this reason, they require advice which facilitates making decisions connected with the market (concerning the choice of a doctor), as well as those connected with health. Properly constructed doctor-patient relationship helps to resolve these dilemmas, but also possesses therapeutic value. Changing socio-economic conditions also alter the character of this relationship. It is worthwhile, therefore, to take a look at the model of doctor-patient relationship currently preferred. Hence, the aim of the research conducted for the needs of this article was to stipulate the preferences concerning the doctor-patient relationship and the identification of the factors affecting the character of this relationship. The research, formulated as a random survey, was conducted with 208 students of two higher learning institutions in the city of Bialystok: the Bialystok Technical University and the University of Bialystok. The article was realized as part of a research grant (no. DEC-2011/01/D/HS4/05664) financed by the National Science Center.

THE PHYSICIAN - PATIENT RELATIONSHIP

Medical services are services which the patients require but not necessarily desire and which are connected with a high level of stress and emotional commitment (Berry, Bendapudi, 2007). The doctor-patient relationships can assume many forms depending on the personal and social predispositions of the doctor and the patient (socio-demographic characteristics, professional authority of doctors, the consumerist attitude of patients, professional socialization of future doctors, the currently accepted model of medicine and health), as well as economic factors (changes in the health care system leading to the development of market mechanisms, competition).

Four models of doctor-patient relationships are mentioned by literature: paternalistic, shared decision making, interpretative and informed choice. Every one of these models is connected to a different attitude of the doctor toward the patient (Cullen, 2005). The paternalistic relationship signifies full submission of the patient to the authority of the doctor, who assumes full responsibility for treatment and its results (Szasz, Hollender, 1956). On the opposite side of the spectrum is the informed choice relationship model, in which the physician comprehensively cooperates with the patient and his family in the domains of health education, prevention, diagnosis and medical problem solving. In this relationship the doctor informs the patient about potential treatment possibilities and their effects (including side-effects), but the final decision is made by the patient. This model assumes that the patient is an equal partner in the relationship (Lagerlov et al., 1998). The third type of relationship – the shared decision making, relies on an authoritative position of the doctor, but it is the patient himself who chooses the level of engagement in the decision-making process connected to treatment, and who has the ability to influence the final course of treatment (Elwyn et al., 2000). In turn, the interpretative model assumes that the basis for meeting at the physician's office is the patient's medical history and the doctor only fulfills the role of an advisor (Eriksson et al., 2007). The essence of the physician-patient relationship is subject to dynamic changes. Researchers claim that the paternalistic relationship type, with the dominant role of the doctor, was characteristic of the past (Gruber, Frugone, 2011). Currently, this model is undergoing a transformation in favor of a more equal distribution of the treatment process control and responsibility on both partners. The relationship is, therefore, becoming more like a partnership and more focused on the patient (Hausman, 2004). In a partner relationship the patient is treated more like a customer who receives essential information from the doctor and then evaluates it and makes decisions based on his own needs (Cullen, 2005). Consumerization of health care, growing access to knowledge and education, formation of internet communities concentrated around health problems, cause the relationship between doctor and patient to undergo further changes (Laing et al., 2005). However, results of some studies show that at times the patients prefer the paternalistic model of the physician-patient relationship (Tapp et al., 2009).

The physician-patient relationship and trust

The relationship between the physician and the patient is conditional on many factors lying on both the patient's and the doctor's side, and is the result of interactions occurring between both parties at the doctor's office (Leventhal, 2008; Spake, Bishop, 2009). These factors include: the assessment of a physician's competence (Brown, Swartz, 1989), psychological comfort of the patient (Spake et al., 2003), empathy, understanding, attention and kindness

displayed by the doctor (Winsted, 2000; Ruyter et al., 1999; Gruber, Frugone, 2011), privacy and confidentiality, as well as integrity. These are behaviors which build trust. Trust could be defined as confidence and the expectation that a partner in a relationship will work toward common interests (Gilson, 2003), and that neither of the sides will ever act to harm a partner by using his vulnerable points against the other (Morgan, Hunt, 1994). This also signifies that there is a will to vest personal assets in the relationship with someone else. Trust is the result of positive images which are the outcome of previously shared interactions (Brockner et al. 1997), and the assessment of the level of credibility of a partner in the relationship.

Patients need trust at every phase of building a relationship with a physician and in every model of such a relationship. Trust is the result of the ability to build a relationship. Trust helps patients to openly speak about their problems and to take part in the co-creation of a medical service and effective treatment (Gruber, Frugone, 2011). Trust also allows the patient to believe the information related by the doctors concerning the arrived at diagnosis or treatment method. Only in cases where it is possible to ensure that the information being passed on by a credible doctor is accepted, patients will view the potential relationship as less risky. Trust also determines the atmosphere of the meeting at the doctor's office, ensuring the patient's satisfaction and loyalty, complying with advice, treatments continuation, and, what follows, faster patient recovery (Hall, 2001). Patients, therefore, look for characteristics and benefits of their interaction with a physician in order to regain trust and continue the relationship (Gruber, Frugone, 2011). Trust in a doctor is, therefore, the result of rational as well as emotional reasons. Previous positive patient experiences connected with a skillful solution of a health problem may become a source of trust. However, positive emotions, bond formation and commitment are no less important in gaining patient trust (Dobiegała-Korona, 2009). The changes which are occurring to the current physician-patient relationship do not signify the depreciation of the meaning of trust. Rather, trust is becoming a negotiable element of the relationship and depends on technical abilities, style of communication, knowledge related to the patient and the ability to prove the accuracy of medical decisions (Rowe, Calnan, 2006).

Physician-patient relationship and stereotypes

Research shows that age, gender or the nationality of a physician may influence the relationship and, in effect, the results of treatment (Shaha, Ogdenb, 2006). The study conducted by Cooper-Patrick et al. (1999) indicates that patients who visited a woman doctor assessed the consultation as more mutually active than in the case of a man. In other studies women were viewed as more focused on interpersonal relations, as showing more support and responding to the emotions of relationship partners, while men were more goal-oriented (Nicolai, Demmel, 2007).

On the other hand, McKinstry and Yang (1994) ascertained that the doctor's age has an influence on the assessment of a relationship. It turns out that while older physicians were viewed as more inclined to listen, of being more thorough and of providing a greater feeling of security, younger doctors were seen as having more up to date knowledge, being more willing to explain and clarify medical questions and preferring more informal ties. Similar results were obtained by Shaha and Ogdenb (2006). In their research they confirmed that young doctors, in the opinions of patients, have better technical skills and are more willing to investigate the emotional aspects of patients' state of health. Patients, in contacts with those

physicians, more readily accept and adhere to the recommendations of the doctor, continue treatment more willingly and show loyalty to the doctor, as well as possess greater confidence in his diagnoses.

METHODOLOGY

Studies connected with the preferred model of physician-patient relationship were mainly conducted in the 80's. For some time this area of research has been somewhat neglected, even though socio-economic conditions have changed, which means that the model of the doctor-patient relationship could have also changed. It is therefore worthwhile to return to studying this issue. Hence, the main goal of the research conducted for the needs of this article was to define the preferences concerning the doctor-patient relationship and to identify factors which influence the character of this relationship. As a result the specific objectives of this study are:

- the impact on the individual dimensions of trust (competence, integrity and benevolence) on the preferred type of doctor-patient relationship;
- the impact of stereotypes on the preferred type of doctor-patient relationship;
- determinants of the model of the doctor-patient relationship (regression model)

The main presumption of the study was to assume the patient's perspective, or to verify the relevance of factors connected to doctor trust and the way they were perceived by the patients.

Doctor trust was therefore studied as trust relating to three dimensions most often quoted by literature: competence, integrity and benevolence. Stereotypes, however, were related to the age and gender of the physician and the location of the medical practice (big city vs. small town). Realization of these goals demanded conducting primary research formulated as a random survey. This being a pilot program only 208 second and third year students of two higher learning institutions: the Bialystok University of Technology and the University of Bialystok, participated in the study. This constitutes significant limitation of the research, because of the defined socio-demographic characteristics of the study sample. Table 1 contains the characteristics of the study sample.

Table 1. Structure of the study sample

Place of residence			**Gender**		
	Number	percentage		Number	percentage
city of Bialystok	104	50,0	woman	124	59,6
village	35	16,8	man	84	40,4
up to 50 thousand	48	23,1	**age**		
50-100	15	7,2	under 25	180	86,5
100-200 thousand	2	0,9	25-35	27	12,98
200-300 thousand	4	1,9	36-45	1	0,5

Net earnings calculated per person in a household			Education level		
do 500	22	11,1	secondary	127	61,0
501-1000	62	31,3	licentiate	58	27,9
1001-1500	57	28,8	higher	23	11,1
1501-2000	28	14,1	**University**		
2001-2500	14	7,1	Technical University of Bialystok	74	35,6
above 2500	15	7,6	University of Bialystok	134	64,4

Source: self study based on research

MODEL OF THE PHYSICIAN – PATIENT RELATIONSHIP –STUDY RESULTS

The aim of the research was to define the type of doctor-patient relationship preferred by the respondents. The participants were given a choice of four short descriptions of these relationships corresponding to the four types of relationships: paternalistic, shared decision making, interpretative and informed choice. It is worth notice that the preferences of respondents are very diverse. Most people, 29% of those studied, expect a paternalistic relationship from their doctor, meaning that they declare a full willingness to submit to the doctor, in line with the conviction that "the doctor knows what he's doing" (table 2).

Table 2. Models of the physician-patient relationships

	Number	Percentage
paternalistic	60	29,0
shared decision making	55	26,6
interpretative	36	17,4
informed choice	56	27,0

Source: self study based on research results

However, slightly fewer participants (27%) expected the opposite type of a relationship, the informed choice, in which the doctor cooperates with the patient and his family informing them about various possibilities of treatment and its consequences. Over 26% of respondents decided that they prefer the shared decision making model. Slightly more than 17% chose the interpretive relationship as the preferred type of contact with their physician.

The identification of factors influencing the choice of the model of the physician-patient relationship became the next research objective. A study of literature proves that the course of this relationship is dependent upon the level of confidence placed in a doctor. The respondents, therefore, had the task of defining the level of their trust in doctors in the following spheres: competence, integrity and their trust in the benevolence and good intentions of the doctor. It turned out that most respondents declared a limited level of trust (the majority of answers state that they mainly trust or do not have a defined position, table 3).

Table 3. Level of trust in the physician-patient relationship

	Trust in competence		Trust in benevolence		Trust in integrity	
	Number	Percentage	Number	Percentage	Number	Percentage
definitely yes	6	2,9	5	2,4	10	4,8
mainly yes	148	71,1	104	50,0	105	50,5
neither yes nor no	35	16,8	68	32,7	65	31,3
mainly no	17	8,2	30	14,4	25	12,0
definitely no	2	1,0	1	0,5	3	1,4

Source: self study based on research

Previous research (Shaha, Ogdenb, 2006; Nicolai, Demmel, 2007) indicates that the model of the doctor-patient relationship is also conditioned by the attitudes and stereotypes guiding the patient concerning the gender, age and the location of the doctor's medical practice. Therefore, the respondents, given a choice: woman-man, younger-older, a big city doctor or small town doctor, were asked to indicate a person whom they most trust as a doctor. Almost 24.5% of them stated that they trust a woman doctor more than a man (table 4). For 62% the question of gender of their doctor was irrelevant.

Table 4. Physician stereotypes

	Frequency	Percentage
Gender		
I trust a woman more	51	24,5
it does not matter	129	62,0
I trust a man more	28	13,5
Age		
I trust a younger person more	29	13,9
it does not matter	96	46,2
I trust an older person more	83	39,9
Place of providing medical services		
I trust a small town doctor more	9	4,3
it does not matter	101	48,6
I trust a big city doctor more	98	47,1

Source: self study based on research results

The age of the physician does not influence the level of trust in him with almost half of the respondents (table 3). Among the others, about 40% trust older doctors more and nearly 14% younger doctors more. Slightly more than 47% of those asked declared that they have a higher degree of trust in physicians practicing in a big city than in a small town (table 4). Here as well, for almost half of the respondents the place of practice does not affect the way of perceiving the doctor.

In order to ascertain which factor explains the patients' decisions concerning the preferred type of a relationship with a physician, a multiple regression model was created. In this model „relationship type" became the dependant variable while the three determinants of trust (competence, benevolence and integrity), stereotypes based on age, gender and the place

of practicing medicine, as well as the economic and demographic variables (such as gender, place of residence and net earnings per person per household) were used as independent variables. The first phase showed that some of the factors were statistically irrelevant, therefore, an attempt to correct the model was made. In the final version the model only contains two determinants of trust: trust in the competence and trust in the integrity of a doctor, as well as the place of residence, net earnings per person per household and those variables illustrating stereotypes based on the size of the town where the practice is located and doctor's gender. The coefficient of determination was R2=0.25 while p=0.00000. A detailed model of the parameters is contained in table 5.

Table 5. The regression model

	b	Std. error - from b	p
Independent variable	3,377100	0,583063	0,000000
Stereotype based on size of city where practice is located	0,636064	0,150681	0,000039
Competence trust	-0,332449	0,133434	0,013631
Net earnings per person per household	-0,199391	0,055805	0,000454
Place of residence	-0,154898	0,064264	0,016950
Stereotype based on the physician's gender	0,189626	0,092537	0,041902
Integrity trust	-0,200877	0,114065	0,079933

Source: self study based on research results

It has been proven that the respondent preferred relationship type is determined to a greatest degree by the stereotypes connected to the size of the city where the medical practice is located (p=0.000039). The relationship type also depends on the doctor's competence (p=0.014) as well as trust in his integrity (p=0.079). Curiously, trust in the benevolence of medical personnel did not fit into the model. Demographic and economic variables, such as earnings per person per household (p=0.000454) and place of residence of respondents (p=0.016950), determined relationship type but to a slightly lesser degree.

CONCLUSION

The physician-patient relationship is a key part of providing medical services (Spake, Bishop, 2009; Gruber, Frugone, 2011). This relationship is dynamic in character and may additionally assume a different form, depending on social predispositions of the doctor and the patient as well as on economic factors. Many authors emphasize that the paternalistic relationship is being replaced by the more balanced contacts between the physician and the patient. The study results show, however, that this is not so definite. Many patients still prefer to submit to the authority of the doctor (paternalistic relationship) than to take responsibility for their medical decisions. The all-present informational chaos (available but unconfirmed knowledge provided by the media) urges patients to look for support in persons possessing professional medical knowledge, may be the source of these types of preferences. The changing role of the physician and the patient should inspire research into the factors which substantially influence the preferred model of this relationship. The results of this study

indicate that stereotypes connected to how a doctor is perceived, especially stereotypes concerning gender and location of the medical practice, are strong and statistically vital factors affecting the course of this relationship. It seems that the more favorable perception of women doctors and those from smaller towns is connected to the preference of the paternalistic relationship. The conducted analysis also permits to conclude that the level of trust in the competence and integrity of the doctor also determines the model of the relationship. Curiously, trust in benevolence of doctors turned out to be completely irrelevant in the choice of the relationship. It is worth mentioning that greater trust both in the competence and in the integrity of doctors is connected rather to the paternalistic relationship than to the informed choice relationship. The expectation of a paternalistic approach of a doctor therefore concerns people who demonstrate a high level of trust.

REFERENCES

1. Berry L.L., Bendapudi, N., (2007), *Health care: a fertile field for service research*, "Journal of Service Research", Vol. 10, Nr, 2, ss.111-122.
2. Brockner J., Siegel P.A., Daly J.P., Tyler T., Martin Ch., (1997), *When Trust Matters: The Moderating Effect of Outcome Favorability*, "Administrative Science Quarterly", vol. 42, ss. 558-583.
3. Brown S., Swartz T., (1989), *A gap analysis of professional service quality*, "Journal of Marketing", Vol. 53, No. 2, ss. 92-98.
4. Cooper-Patrick L., Gallo J.J., Gonzales J.J., Thi Vu H., Powe N.R., Nelson C., Ford D.E., (1999), *Race, gender and partnership in the patient–physician relationship*, "The Journal of the American Medical Association", 282(6), ss. 583–589.
5. Cullen R., (2005), *Empowering patients through health information literacy training*, "Health Education", Vol. 54, no. 4, ss. 231-244.
6. Dobiegała-Korona K., (2009), *Zaufanie jako przesłanka współtworzenia wartości*, w: Garbarski L., Tkaczyk J. (red.), *Kontrowersje wokół marketingu w Polsce. Niepewność i zaufanie a zachowania nabywców*, Wydawnictwa Akademickie i Profesjonalne, Warszawa.
7. Elwyn G., Edwards A., Kinnersley P., Grol R., (2000), *Shared decision making and the concept of equipoise: the competences of involving patients in healthcare choices*, "The British Journal of General Practice", 50(460), ss. 892–899.
8. Eriksson T., Nilstun T., Edwards A., (2007), *The ethics of risk communication in lifestyle interventions: Consequences of patient centredness*, "Health, Risk & Society", vol. 9(1), ss. 19-36.
9. Gilson L., (2003), *Trust and the development of health care as a social institution*, "Social Science & Medicine", vol. 56, ss. 1453-1568.
10. Gruber T., Frugone F., (2011), *Uncovering the desired qualities and behaviours of general practitioners (GPs) during medical (service recovery) encounters*, "Journal of Service Management", Vol. 22 Nr, 4, ss. 491-521.
11. Hall M., Dugan E., Zheng B., Mishra A.K., (2001), *Trust in physicians and medical institutions: What is it, Can it be measured, and Does it matter?*, "The Milbank Quarterly", Vol. 79, no 4, ss. 613-639.
12. Hausman A., (2004), *Modeling the patient-physician encounter: improving patient outcomes*, "Academy of Marketing Science Journal", Vol. 32, No. 4, ss. 403-417.

13. Kao A.C., Green D.C., Davis N.A., Koplan J.P., Cleary P.D., (1998), *Patients' Trust in Their Physicians. Effects of Choice, Continuity, and Payment Method*, "Journal of General Internal Medicine", vol. 13(10), ss. 681–686.
14. Lagerlov P., Leseth A., Matheso I., (1998), *The doctor-patient relationship and the management of asthma*, "Social Science & Medicine", Vol. 47, nr, 1, ss. 85-91.
15. Laing A., Newholm T., Hogg G., (2005), *Crisis of confidence: re-narrating the consumer professional discourse*, "Advances in Consumer Research", Vol. 32, No. 1, ss. 514-21.
16. Leventhal L., (2008), *The role of understanding customer expectations in aged care*, "International Journal of Health Care Quality Assurance", Vol. 21 No. 1, ss. 50-59.
17. McKinstry B, Yang S.Y., (1994), *Do patients care about the age of their general practitioner? A questionnaire survey in five practices*, "British Journal of General Practice", vol. 44, ss. 349–351.
18. Morgan R.M., Hunt S.D., (1994), *The commitment – trust theory of marketing*, "Journal of Marketing", vol. 58 (3), ss. 20-38.
19. Nicolai J., Demmel, R., (2007), *The impact of gender stereotypes on the evaluation of general practitioners' communication skills: An experimental study using transcripts of physician–patient encounters*, "Patient Education and Counseling", vol. 69, ss. 200–205.
20. Rowe R., Calnan M., (2006), *Trust relations in health care—the new agenda*, "European Journal of Public Health", February, vol.16 (1), ss. 4-6.
21. de Ruyter K., Wetzels M., van Birgelen M., (1999), *How do customers react to critical services encounters?: A cross-sectional perspective*, "Total Quality Management", Vol. 10, No. 8, ss. 1131-1145.
22. Shaha R., Ogdenb J., (2006), *'What's in a face?' The role of doctor ethnicity, age and gender in the formation of patients' judgements: an experimental study*, "Patient Education and Counseling", vol. 60, ss. 136–141.
23. Spake D., Bishop J., (2009), *The impact of perceived closeness on the differing roles of satisfaction, trust, commitment, and comfort on intention to remain with a physician*, "Health Marketing Quarterly", Vol. 26 No. 1, ss. 1-15.
24. Szasz T.S., Hollender M.H., (1956), *A contribution to the philosophy of medicine*, "A.M.A. Archives of Internal Medicine", vol. 97, ss. 585-592.
25. Tapp L., Elwyn G., Edwards A., Holm S., Eriksson T., (2009), *Quality improvement in primary care: ethical issues explored*, "International Journal of Health Care Quality Assurance", Vol. 22, No. 1, ss. 8-29.
26. Winsted K.F., (2000), *Patient satisfaction with medical encounters: a cross-cultural perspective*, "International Journal of Service Industry Management", Vol. 11, No. 5, ss. 399-421.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

MEASURING AND DEVELOPING CUSTOMER SATISFACTION - WITH THE BALANCED CRITICAL FACTOR INDEX METHOD

Mika Kuronen*, Department of production/Industrial management, University of Vaasa, Po. Box 700, FI-65101, Vaasa, Finland
Mika.Kuronen@student.uwasa.fi

Josu Takala, Department of production/Industrial management, University of Vaasa, Po. Box 700, FI-65101, Vaasa, Finland
Josu.Takala@uwasa.fi
***Corresponding author**

ABSTRACT

This short analysis presents perspective and a holistic method for approaching and measuring customer satisfaction. The Balanced Critical Factor Index (BCFI) method is a measurement tool to indicate which attribute of a business process is critical and which is not, based on the experience and expectations of the company's employees, customers or business partners.

This paper focuses on to detect and define critical business processes and factors, which have influence to effective co-operation and customer satisfaction. The use of a questionnaire is one of the most efficient approaches to gather the required information. Due to the fact that each process has its own attributes and the questionnaires cannot be standardized, but the information from the phase is essential and could be measured. In this study case company's all gathered information will be analyzed and furthermore the BCFI measurement tools will be applied. The original research has been testified that, with the above-mentioned method (BCFI) customer's experience of the "gap" between expected and received service can be easily resolved. Using this BCFI method it is also possible to find easier so called "weak" customer satisfaction indicators, which are not directly obvious. Companies have crucial to take the right decisions upon the areas of business interest. To have it done, the company should have able to made decisions with the right amount of customers needs. The correct allocation and fast adaption of customer's needs with the right amount of standards is a key to competitive advantage. This paper shows use of this BCFI method and how it could help companies to define there's customer's needs and required development target area more specifically.

Keywords: Customer satisfaction; Critical business process; Balanced Critical Factor Index (BCFI); Method.

INTRODUCTION

The objective of this review is to introduce Balanced Critical Factor Index method (BCFI) and it's use in the development and measuring of customer satisfaction. Original research satisfaction survey answers were collected from two years (2010 -2011) and were totally consisted of 357-answerer from 6 different organisation levels. Study's case company is responsible for the material maintenance and sparelogistics for the Finnish Army and it produces these maintenance services, either directly or managed by its subcontractors. Company is also responsible of the systems, which are related to conversion, integration and outfitting work or materials in some advance determinate projects.

How we can describe customer satisfaction?

How we can describe the customer satisfaction? This question could have as many answers as there are respondents. Customer satisfaction can mean very different things among to the answerer. It may include such factors as delivery time, price, conformity, professionalism, or it is generally just a responce to customer' requests. It can also be all of these above mentioned issues or other else factors in a complex mix. The concept of customer satisfaction can be very different in different industrial sectors or even within the same company in the different product lines (Kokkonen 2006.).

General limitation of the customer satisfaction is mostly just thinking that "it comes form a customer on the basis of the needs they are expressed". The starting point for developing customer satisfaction is often not a deep understanding of the needs. Cursory customer orientation may even lead to the situation there companies are adapting and carry out "wrong" customer needs. This situation means that company's strategic planning are even supposed to work up to with customer's wishes. Because neither or party of this, the development of customer satisfaction is in the most cases formed properly "after it has came a serious business development brake". (Storbacka & Lehtinen 2002: 17.).

Measuring of Customer satisfaction?

In general: Customer satisfaction surveys main objective is to measure answerer's satisfaction level of experienced services. Before starting of the measurement process is important to find out some basics: Why you want to carry out chosen measurements? Are they really important and what of these measurements can be really ascertained? In addition to the make successful data analysis, successful customer satisfaction surveys requires right questions with the right scale. Customer satisfaction surveys outcome should be linked to factors, which are most critical to organization's success. A critical success factor is the key business area in the company and that for it must achieve a high level of performance. Organization success can vary and be reliant of many things, but measuring of customer satisfaction should commonly concentrate only a few selected critical success factors[1] (Lönnqvist & Pirttimäki 2006).

[1]Study's case company did not validate used customer satisfaction attributes to use with the BCFI method

- An adequate level of service?

One of the good known implementation of customer satisfaction implementation is Zeithaml's etc. (1985) developed SERVQUAL instrument cluster. This method is based on the idea, that the customer's perception of service quality is best formed when customer ecpectations of service quality are compared to the provided service level. (Zeithaml, V., Parasuraman, A., Berry, L. 1990: 25.). Include to the Zeithaml & Bitner (1996) customer service quality have two level ecpectations what are: desired level of service and observed service level. Desired service level is the level of service that the customer expects to receive. Between those levels is so-called adequate level of the service, which is still acceptable to the customer ecpectations. This acceptable service area may be very different depending from the client and the situation. (The customer's expectations, Zeithaml etc. 1996:76-78).

- The Importance & Performance method

This method is approaching customer satisfaction with importance and effectiveness of the selected service area. This model allows each attribute to be measured with the clear priorities and activities (Martilla & James 1977: 78–79). Used questionaire can be divided to "important" and "not important" according to the customer's experience and each attribute have also "better" or "Worse" value depending of respondents experience. These importance & performance results can be present and interpreted for example by SWOT analysis (Key & Yavas & Riecken 1994: 36–37.). Figure 3. Importantance & Performance review.

USE OF THE BCFI METHOD

Balanced Critical Factor Index (BCFI) method has development in the University of Vaasa 2010. It calculates the standard deviation of the given question attributes. BCFI method can be used to find (from research attributes) the most critical attributes, which may be assumed to be the most importance for formation of organisation, but also the permormance. The BCFI formula takes account all expected values and experienced values into demanded activity or service related. Into Formula placed values "total" is the so-called BCFI value. Question attributes are more significant then BCFI value is closer to the value of zero (0), but also those attributes, which value is considerably higher than the other values are significant. BCFI method produces the best benefit if the past and future values can be calculated separately, but the method is however developed in such a way that these values can be counted separately. Generally BCFI methods divide processing of the material into three phases, which are:

- *The current assessments of the situation and the observation of situation,*
- *Determination of appropriate attributes to find critical factors,*
- *Data analysis with the BCFI method.*

Step one (1) include a preliminary mapping of organization needs. This step aim is to find necessary processes, phenomena, and the people who have influence on the matter. Step two (2) purpose is to identify and define all necessary attributes that are linked to the above matters.

Questions respondents assessments task is to quantify the importance of these attributes with numerical value: in the past and future tense, and this gives the content of its weight. In the third (3) section is data analysis stage which is carried out throughout the following formula[2] Figure 1:

GAP INDEX (GI)	$\left\lvert \frac{(\text{av. of expr} - \text{av. of expc}) * 1{,}3}{10} \right\rvert - 1$
DIRECTION OF DEVELOPMENT INDEX (DDI)	$\left\lvert \frac{(\text{better \%} - \text{worse \%}) * 0{,}9}{100} \right\rvert - 1$
IMPORTANCE INDEX (II)	$\frac{\text{average of expectation}}{10}$
PERFORMANCE INDEX (PI)	$\frac{\text{average of experience}}{10}$
STANDARD DEVIATION EXPECTATION INDEX (SD expc I)	$\left(\frac{\text{SD of expectation}}{10}\right) + 1$
STANDARD DEVIATION EXPERIENCE INDEX (SD expr I)	$\left(\frac{\text{SD of experience}}{10}\right) + 1$
BCFI FINAL FORMULA	$\frac{\text{SD expc I} * \text{SD expr I} * \text{PI}}{\text{II} * \text{GI} * \text{DDI}}$

Fig. 1. The BCFI method formula

- General findings?

All respondents and groups deliver almost same results (shaped curve), when results where compared to each other. All defendants had all the questions very high expected values, which exceeded almost invariably themselves for the success of the estimates, what was given (figure 2. Average expected values and results).

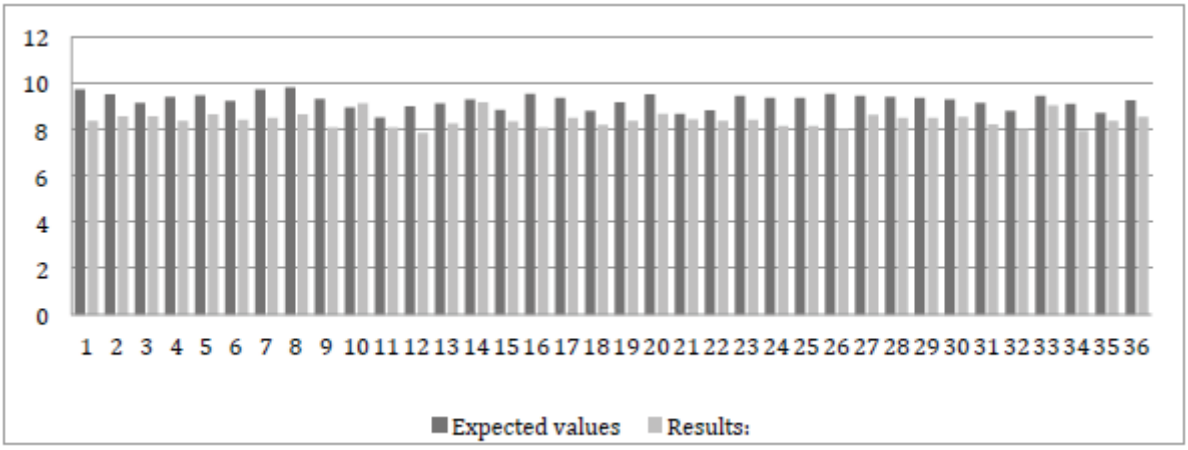


Fig. 2. Average expected values and results

[2] Forss &Takala & Korpi & Golovko 2010

Main results with the BCFI-method?

Questions (1–13) BCFI values are clearly higher than the values of rest of questions. Below is presented organisational management par table, but rest of groups gave very same kind of results. Results' ranging with the BCFI was from ~ 0.10 up to 1.40. (Figure 3. BCFI values).

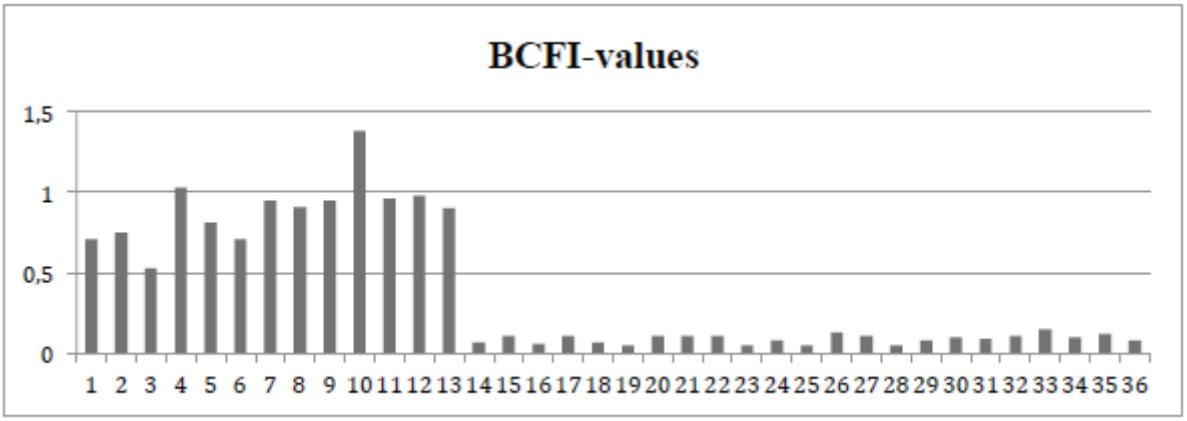


Fig. 3. BCFI values

CONCLUSIONS

If we compare these results to the adequate service areas, more precisely the main target is in the experienced service in quality, availability and delivery. This is interesting because expected and received service levels are where not indicating anything like that? An adequate level of service thinking could lead to wrong conclusions? According to these BCFI values, the customer satisfaction "gap" is not customer service itself or generally lack in all services. These results are now clearly pointing to questions 1–13, which are presented below:

1. The ability to understand the customer's business,
2. Cooperation in general fluency,
3. Operational flexibility,
4. General efficiency,
5. Customer orientation,
6. Goal of activities,
7. Openness and honesty in collaboration,
8. Reliability partner,
9. Observing the Customer needs,
10. Anticipating of changes,
11. Communication and information sharing in general,
12. Communication/ information sharing clarity
13. Continuous development.

- The gap in communication or quality specifications?

Low BCFI values in questions 14-64 could mean that company have erroneously decoded data expectations and management will have a lack of information about the organization. Now seems that, customer is dissatisfied of certain services specifications. There could be too many layers of the organization, which will stop or change the information that comes through from the customer. A main objective in quality specifications may not be a clear and the design of services could be inaccurate or self-design process could have insufficient. The quality of services could not committed to a an sufficient extent and these quality qaps could means that the service separation are not uniform with consistent quality expectations. Questions 14-64 are presented in appendix 1.

- The service delivery gap?

Specifications could be now too complex or rigid and the specifications are therefore not enought accepted. The protocol was not enought to consistent with the company's culture and service delivery was mismanaged. All these delivery involved qaps means that technology or systems do not support all the activities. These results get support from Importance & Performance method, Figure 3: Importantance & Performance review:

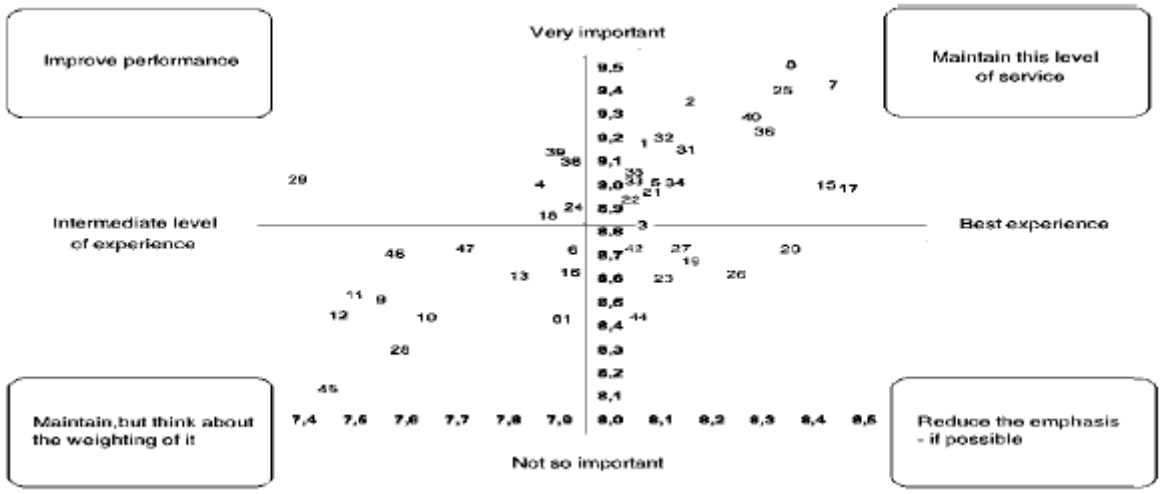


Fig. 3: Importance & Performance rewiev

- Things to be improved?

- Question 4: The efficiency of service,
- Question 18: Service speed,
- Question 24: Change/problem situation management,
- Question 29: Information sharing in missing or problematic deliveries
- Question 38: Delivery capacity,
- Question 39: Delivery accuracy.

RELIABILITY OF THE STUDY

Research empirical material is based on the results of case company's customer satisfaction survey, which was performed by years 2010–2011. Customer Satisfaction wetted a total of 64 questions. Study's original customer satisfaction data was bossible to divide into different levels of the organization and there was also bossible to pick up the same respondents for the years 2010 and 2011. Research defendants there the Finnish Armed Forces maintenance regiments employees. They there grouped by levels of the organization as follows. To verify study's information between survey respondents they were also asked information about the their's position, organization code and post office code. Organization levels where:

1. Management of the organization,
2. Material projects and procurement,
3. Maintenance management,
4. Maintenance and logistics planning and control,
5. Maintenance supervisory responsibilities,
6. General maintenance tasks.

The original survey was performed with qualitative and quantitative methods. Standardized quantitative statistical research methods can be used in variety ways for analyzing data. The numerical values importance conclude are the measured results statistically significant or not significant. Normally the most commonly used significance is 0.05 and separation or dependence can be almost considered to be statistically significant, where $0.01 < p < 0.05$ and significant, when $0.001 < P < 0.01$ (Uusitalo 2001: 82). For testing relationship of variables are commonly used two dimensional testing and this test is based on two or more statistical variable. Suitable method for analyze results is a cross-tabulation, which explains rated effectiveness of two variables against each other, and the Pearson correlation coefficient, which is the most commonly used method. This method can be use to test two or more variables dependencies. In general using only these two methods it is not recommended to made causal conclusions, because these methods shows only the linear dependencies (Heikkilä 2000: 191–202.). In this research study material contained attributes are evaluated with average testing and the standard deviation based on the BCFI method. The significance of the results where obtained, but the difference between dependencies should evaluate by reflecting it to whole framework.

REFERENCES

1. Hirsjärvi, S., Hurme, H. (2000). Tutkimushaastattelu. Teemahaastattelun teoria ja käytäntö. Helsinki: Yliopistopaino.
2. Heikkilä, Tarja. (2001). Tilastollinen tutkimus. 3. uudistettu painos. Helsinki: Oy Edita Ab.
3. Homburg, C., Rudolph, B. (2001) Customer satisfaction in industrial markets: Dimension and multiple role issues. Journal of Business Research, Vol 52, No. 1, 15–33.
4. Keyt, John. C., Yavas, U., Riecken, G. (1994). Importance – performance analysis. International Journal of Retail & Distribution Management, Vol. 22, No. 5, 35-40.
5. Kokkonen, Olavi. (2006). Asiakastyytyväisyys kaiken perusta [online].<*http://www.sixsigma.fi/?sivu=Artikkeli&id=90*>.

6. Lönnqvist, A., Pirttimäki, V. (2006). The Measurement of Business Intelligence. International Journal of Information System Management, Winter 2006 Vol 23, 32-41.
7. Martilla, J. A., James, J.C. (1977). Importance & Performance Analysis. International Journal of Marketing (1977).
8. Storbacka, K., Lehtinen, Jarmo. R. (2002). Asiakkuuden ehdoilla. Asiakkuuden armoilla. Viides painos. Juva: Täydellinen Asiakkuus OY ja WSOY WS Bookwell Oy.
9. Takala, J., Nadler, D. (2010). The Development of the Critical Factor Index Method. International Journal of Services and Standards.
10. Teppo Forss, Josu Takala, Heli Korpi, Ivan Golovko 2010. Sustainable operative housing by dynamic renting. Management and Production. Vol 1. Number 2. July pp 10 -20.
11. Zeithaml, V.A., Bitner, M.J. (1996). Services marketing. McGraw-Hill. Zeithaml, V., Parasuraman, A., Berry, L. (1985). A Conceptual Model of Service Quality and its Implications for Future Research. International Journal of Marketing. 40-50.
12. Zeithaml, V., Parasuraman, A. & Berry, L. (1990). Delivering Quality Service. Balancing Customer Perceptions and Expectations. New York: The Free Press. Zeithaml, V.A., Bitner, M.J. (1996). Services Marketing. McGraw-Hill.

APPENDIX 1:

Question attributes 14-64:

14. What items needs development in general*
15. Services availability?
16. Is communication sufficient?
17. Company's willingness to serve?
18. Speed of service
19. Speed for responding to calls
20. The willingness to listen
21. The ability to understand the needs
22. The ability to find solutions and meet the needs
23. Contract management
24. Change and problem situation management
25. Meaning for you - keeping promises?
26. Meaning for you - ability to receive feedback?
27. Meaning for you - activity in cooperation?
28. Information sharing in a missing or problematic delivery?
30. The availability of services?
31. The quality of services?
32. Performance of services?
33. Conformity of services?
34. Ability to support customer activities in the past year?
35. Company's ability to produce annual ordered services?
36. How would you like company's services develop in the future?
37. Company's ability to deliver ordered goods?
38. Deliveries accuracy?
39. Are deliveries exact?
40. Company's response rate in transformation situations?
41. Flexibility to order and delivery changes?
42. How would you like to improve supplies and logistical efficiency in the future? *
43. Quality of advisory services?
44. Access to education?
45. Billing accuracy/clarity?
46. Complaints handling?
47. How would you like company's support processes developing in the future?*
48. Company's success, overall?
49. A: Are all services produced with the one stop principle?
50. B: Is company a neutral and impartial in producing this one stop principle?
51. Which way would you rather receive company's press releases? By letter or electronically*
52. How company should consider developing of e-services?*
53. Other feedback or suggestions for company? *
54. Do you hope that company will contact you?
55. Which particular things or case?
56 - 57. Best time to contact* (56, 57 where almost same questions)
58. Coverage of services?
59. How company's operation progressed in last the year*
60. How company's support processes developed during the past year*
61. How company's logistics are developed during the past year*
62. How company's services are developed during the past year*
63. How company's customer service or support to services are develop during past year*
64. How company's services support your activities*

Responce asked with verbal answer *

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

PUBLIC BUSINESS SERVICES IN A SPARSELY POPULATED AREA – CASE STUDY

Martti Saarela*, Oulu Southern Institute, University of Oulu, Finland
martti.saarela@oulu.fi
***corresponding author**

Eija-Riitta Niinikoski, Oulu Southern Institute, University of Oulu, Finland
eija-riitta.niinikoski@oulu.fi

Matti Muhos, Oulu Southern Institute, University of Oulu, Finland
matti.muhos@oulu.fi

ABSTRACT

Purpose: *In Finland, customers often view public business services as being a multifaceted, complex and scattered system. Service providers in sparsely populated areas are facing context-specific challenges as they provide services for their customers. The aim of this study is to describe what kinds of business services are provided for early-stage companies in the sparsely populated case region and to investigate how customers evaluate the importance and success of provided services.*
Design/methodology/approach: *This is a retrospective single case study focusing on a sparsely populated subregion in Northern Finland. The case study devises a four-stage configuration framework to describe the current state of public business services and to reflect the customer experiences related to these services. The study uses semi-structured interviews and surveys for data collection. Multiple perspectives were analysed in the interviews for triangulation.*
Findings: *This study describes public business services, especially for early-stage SMEs, in a sparsely populated region. As a result of this case study, key characteristics of organising public business services in sparsely populated area context are described. The success and importance of the public business services from the service customers' perspective are clarified.*
Research limitations/implications: *This descriptive case study is limited to a single sub-region of a sparsely populated Northern Finland to get an in-depth understanding of the phenomenon.*
Originality/value: *Current literature provides limited information about how to effectively and successfully organize public business services in sparsely populated areas. This study evaluates how services correspond to the needs of the customers and how customers evaluate the importance and success of the business services in the sparsely populated case area.*

Keywords: public business services, sparsely populated area, SME, stage models, growth

INTRODUCTION

According to a recent report (Ministry of Employment and the Economy, 2012), there is a vast number of public business services in Finland. However, the services are complex and scattered from a company perspective. Partly due to project-based funding, the field remains mixed and changes frequently. Services are provided by national organisations, as well as by regional agencies, such as science and technology parks and centres, regional development agencies and incubators.. According to the Evaluation of the National Finnish Innovation System (Veugelers, 2009), Finland´s research and innovation system is complex and fragmented. This concerns a business support system, which small and start-up companies in particular experience as difficult. The challenges particularly affect innovative and entrepreneurial support at regional levels. The support system has overlapping functions and unclear organizational roles between actors. Even if the innovation system as a whole can be seen to work satisfactorily, small, rapid-growth companies are not served well and achieve poorer results.

Entrepreneurship drives the economy of most nations. Small- and medium-sized enterprises (SMEs) are considered an important and integral part of every country's economy; SMEs are the fastest growing sector of many economies and are more flexible and adaptable concerning their structure and their ability to respond more quickly than larger organisations (Tagliavini *et al*., 2001; Yifeng, 2011). On the other hand, compared to large enterprises, SMEs typically have fewer financial resources, less technical expertise and more limited management skills (Blili and Raymond, 1993; Yifeng, 2011). A successful SME sector can be considered a vital part of growth and development in sparsely populated regions. Moreover, in Finland the national strategy is to enhance SMEs.

A company's number of employees, sales and assets indicate business growth; however, management must focus on multiple dimensions in a growing company. The majority of perspectives dealing with company growth are concerned with the factors leading to growth. However, this study deals with the actual growth process. Researchers label this perspective the stages of growth, company lifecycle or configuration perspective (see e.g. Muhos *et al*., 2010; Muhos, 2011). Numerous models have attempted to clarify managerial challenges and priorities in the early stages of companies (see e.g. Churchill and Lewis, 1983; Greiner, 1972). This perspective relates to what growth brings to a company and how to manage a growing company (see Davidsson and Wiklund, 2006; Wiklund, 1998). Growth configuration literature reveals diverse managerial problem configurations specific to the different growth stages.

A simplified four-stage framework, a synthesis of recent stage models (see Muhos *et al*., 201n [in press]), is utilized in this study to explore business services and development activities for early-stage companies provided by public business services. The key characteristics of the framework are presented in Figure 1 below.

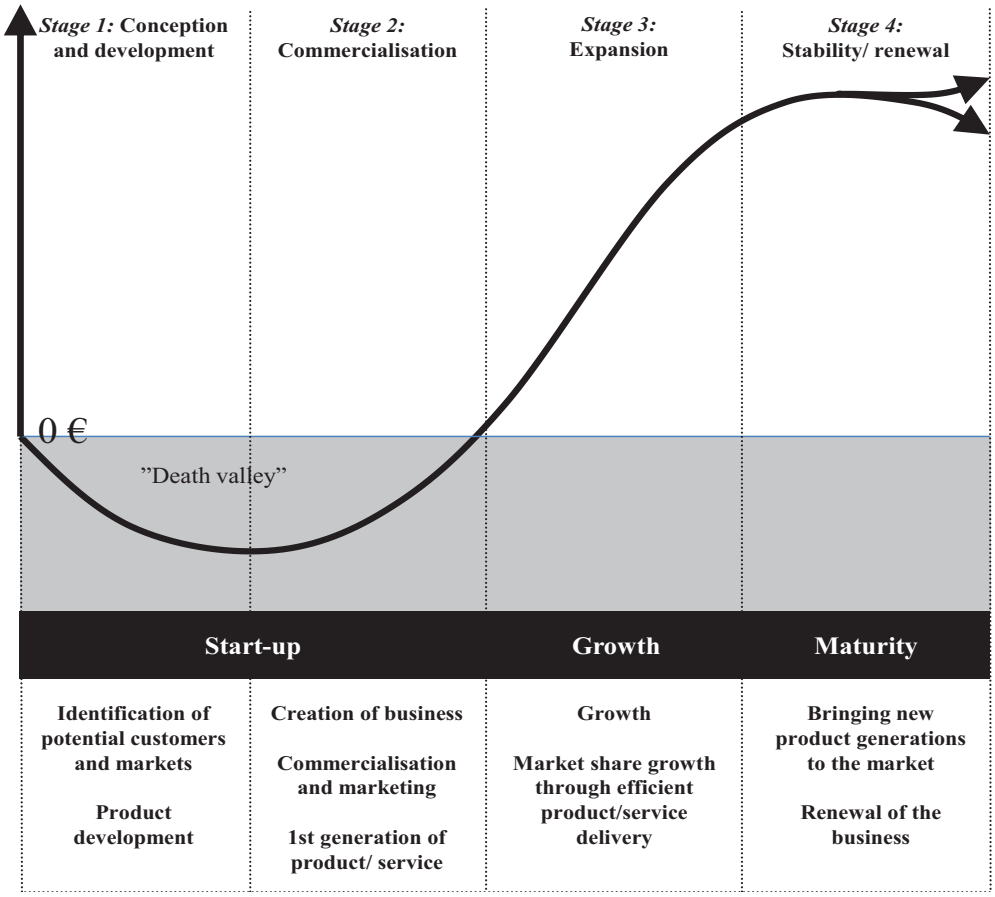


Figure 1: The simplified stage framework

Rurality can be defined in traditional descriptive terms, including the level of population density, the rate of population loss or gain, settlement size, local economic structure and landscape (Stathopoulou *et al.* 2004). Rural businesses tend to be small, and small businesses in rural communities face geo-demographic, socio-cultural and economic concerns. Remoteness brings about transportation challenges as well as increases in manufacturing costs and longer workforce commutes. Low population density may also limit the available skilled labour as well as employment options. The per capita, household income and educational level of rural residents tend to be low in comparison to their counterparts in urban areas, and rural businesses may lack sufficient access to financing. In the European Union (Eurostat, 2012) sparsely populated areas are defined as regions with a population density below a certain threshold; the region is defined as sparsely populated if it has a population density of fewer than 12.5 inhabitants per km². Northern parts of Finland, Sweden and Norway and the majority of Iceland can be defined as sparsely populated areas.

The case region of this study, the Nivala-Haapajärvi subregion, consists of five municipalities: Haapajärvi, Kärsämäki, Nivala, Pyhäjärvi and Reisjärvi, with a total population of approximately 30,000 inhabitants. The area is located in the southern part of Northern Ostrobothnia in Finland. It covers an area of nearly 4000 km2. There are about 1600 companies in the subregion; the majority of them (95%) are micro-sized companies. Industry, services and primary production comprise about 70 % of the jobs. The growing

industrial sectors include the metal and wood products industries. The metal industry, including the construction of metal structures and machinery, equipment manufacturing and mechanical engineering, has strongly increased its workforce in recent years The Nivala-Haapajärvi subregion is the leading region in milk and meat production in Finland. Besides agriculture, forestry has a significant impact on employment in the area as well.

This study's research problem can be condensed into the following research questions:
1. What kinds of business services are provided for early-stage companies in the case region?
2. How do customers evaluate the importance and success of these provided services?

These questions are studied by analysing the supply of services in the case region. By investigating the case, this study explores how public business services are organised in this sparsely populated area and describes the services provided for early-stage companies. In addition to that, the study clarifies how public business services correspond to demands. In addition, the importance and success of the services are evaluated both from the providers' and the customers' perspectives.

METHOD

This is a case study with a holistic strategy; the power of a case study is in clarifying complicated processes and in obtaining new knowledge when the boundaries between a phenomenon and its context are not clearly evident and in which multiple sources of evidence are used (Yin, 1994).

The empirical evidence for this study was collected by interviewing the representatives of NIHAK, which is a business development company of the Nivala-Haapajärvi subregion, and by collecting survey data from the customers of NIHAK. The collected data and the received evidence was further analysed and synthesized.

The first part of the empirical evidence was collected at the end of 2011 and in the beginning of 2012 by interviewing the Chief Executive Officer, the Business Development Manager and the Project Manager of NIHAK. All interviews were conducted using a similar research process and thematic questionnaires. The main thematic sections of the interview are provided in Table 1,

Table 1. The main thematic sections of the interviews

Section	Theme
1	Clarification of the purpose of the interviews
2	Basic information about the organisations and the interviewees
3	General description of the services provided by the organisations and their customers
4	Orientation to the stage framework
5	Stage-specific description of the services provided for SME companies in their early stages
6	Evaluation of the services provided
7	Description of successful cases and best practices

The second part of the empirical evidence was collected during the spring of 2012 by surveys sent to the customers of public business services in the Nivala-Haapajärvi subregion (NIHAK). The internet based survey was sent to 857 companies. A total of 129 responses were received before the survey deadline, the response rate being 15 %. Almost half of the respondents were one-person micro-sized companies. The main themes of the questionnaire are presented in Table 2.

Table 2. The main thematic sections of the questionnaire

Section	Theme
1	Basic information about respondents
2	General evaluation of the public business services and service organisations of the region
3	Description of the emerging needs for new services (general level)
4	Evaluation of the importance and success of public business services provided for early-stage companies (stage-by-stage)
5	Description of the emerging needs for new services for early-stage companies (stage-by-stage)

RESULTS

The Nivala-Haapajärvi subregion (five municipalities, 30,333 inhabitants, 1600 companies) has arranged its business development services via the development company NIHAK, which is operating as a limited company. NIHAK is a municipal producer and its duty is to develop the region, together with its member municipalities and partners, by means of programme-based regional development. The aim of the business development services is to develop several kinds of business activities, excluding primary production in agriculture and forestry, which are the responsibility of other actors/organisations.

Table 3: Description of the Nivala-Haapajärvi subregion

	Nivala-Haapajärvi subregion
Organisation of services	NIHAK
Municipalities	Haapajärvi, Kärsämäki, Nivala, Pyhäjärvi and Reisjärvi
Inhabitants	30,333
Number of enterprises	1600

Interview results

The public business development company NIHAK has 10 employees working with entrepreneurs.

The roles of the personnel are divided in such a way so that the personnel have both a horizontal (thematic) responsibility (e.g. the incubation services and the services of the growing enterprises) and a vertical (local) municipal business development consultation responsibility. In every member municipality, there is a business development manager and an agency where the entrepreneur receives a start-up package containing information on

business development services with the principle of a 'single window' system. The business development managers respond to the business development services in their 'own' municipality, but co-operate with each other as a network, depending on their areas of expertise, for the benefit of the subregion.

The subregion's business development services have been segmented and productised in the NIHAK in the way that commencing enterprises, operating enterprises, innovation enterprises, enterprises becoming international, and domiciliary services are represented each in a group of their own. Based on the interviews, the main content of the service is recognising and understanding the process and the lifecycle stage of the business activity and then offering the right service. Clients receive information from the business development services about such things as start-up grants, business development assistance and loans and securities for loans. Moreover, acquisition and other ownership change-related services are offered. Business development services are confidential and free of charge for clients.

In addition to producing the services, NIHAK is an agent for the services provided by the local, regional and national cooperation partners, including such things as manufacturing studios, premises and international services. In this study's interviews, NIHAK is regarded as an immediate interface between the enterprises, society and the public economy. Several actors participate in the cooperation coordinated by NIHAK. The development companies need personnel to have sufficiently broad know-how and readiness concerning the services offered by the cooperation partners, so that the company's role as an intermediary organisation works. The NIHAK business development managers also act as intermediaries and consultants when they search for a suitable service concept for the client enterprise.

Based on the interviews the proactive nature of the services is pointed out. The business development managers contact the enterprises in the region annually. In the development discussions they make every attempt to understand the enterprise's situation so they can provide sufficient information about the specific services that best fit the company's needs. NIHAK has organized the business services it provides to the many areas of region through its business development managers, which is often the strength of local service and a direct link to broader business service networks.

Services for enterprises in the conception and development phase include general enterprise consultation, enterprise start-up consultation and grants. In addition, business idea development, surveys of grant opportunities, evaluations of profitability, different kinds of plans (e.g. a business activity plan), financial statements, financial planning and applications for financing are offered. There is also an incubation service, which is directed especially to commencing enterprises and young enterprises, as well as for those who start up and develop new business activities and have opportunities to expand. Innovation services, like the protection of innovations and building up development services, suit the enterprises in this phase. Additionally, NIHAK offers with its partners training in enterprising, manufacturing studios, premises and internationalisation services.

A typical case of a commencing entrepreneur is when the business idea and its likelihood of success are first estimated. In connection with the business idea evaluation, possibilities for getting start-up grants are surveyed and applications for such grants are made together with the entrepreneur. Financial needs and potential sources of financing (e.g. a bank and other

funding actors) and the quality are evaluated next. For example, the TEKES (the Finnish Funding Agency for Technology and Innovation) provides financing for the development projects. After the survey and applications the actual business start-up documents are created. At the same time the issues concerning the choice of a company form, its grounds, risks, responsibilities and taxing are reviewed.

Services directed into the commercialisation phase are the incubation, where the enterprise is developed in cooperation with consultants. Targeted training is also available. Often general business development consultation with the right questions for the entrepreneur offers the necessary help for an enterprise. As an intermediary organisation NIHAK has also recommended e.g. the marketing and sales programme offered by the ELY-Centre (The Centres for Economic Development, Transport and the Environment).

NIHAK's role as an intermediary organisation is emphasized when the enterprise being served is in the expansion phase. The expertise of NIHAK is utilized for instance in budget calculation. Typical services offered in this phase are financial planning and applications for financing. Several kinds of challenges become current; the manufacturing is e.g. not able to respond to sales growth. Problems may appear with the production management, quality management systems, financing, working capital, increases in staff and recruitment. To recognise the acute sticking points and bottlenecks, an enterprise may need outside expertise that NIHAK can offer. All internationalisation services, e.g. the shared export secretary service, can also be seen as expansion phase services.

Based on the interviews, the stability and renewal phase is also interesting because some of the enterprises are content with their stability and are not trying to reach growth. Business activity stabilises in this phase, and in the absence of growth desires, there are no longer significant needs for utilising business development services. As far as an enterprise has the desire and the need for a renewal, a stage of expansion with new investment planning may often come up. There may be a need for an expert from outside to help as well. In this phase the change of ownership may become necessary in the enterprise's development. If the entrepreneur is interested in abandoning the enterprise, NIHAK can cooperate in implementing the acquisition. NIHAK can negotiate with the purchasing candidates from outside. In addition, family business succession is promoted.

Business services and development activities for early-stage companies provided by NIHAK are described in Table 4.

Table 4. Business services and development activities provided by NIHAK for early-stage companies

	Stage 1: Conception and development	Stage 2: Commercialisation	Stage 3: Expansion	Stage 4: Stability/ renewal
Nivala-Haapajärvi subregion	- Business plan - Establishing the business - Planning and seeking financing - Developing the business idea - Assessing profitability - Constructing development projects - Business incubation	- Planning and seeking financing - Surveying the business situation and development needs - Building development projects - Training	- Planning and seeking financing -Export specialist services -Trade fair and contact services - Building development projects - Studios as development environments	- Planning and seeking financing - Monitoring the business situation and development needs -Building development projects - Services upon ownership and generational changes

General business consulting and intermediary organisations' actions are included in all cells of the above presented table. The support actions of public business services are not always productised, but they are tailored to customers' needs. Third party solutions are offered when a service portfolio does not meet the specific needs of a customer. These can be offered through the partner networks.

Based on the interviews, the services and the needs of established and start-up companies seem to be fairly similar without any larger gaps. From the perspective of service providers, targets for future development are expressed location services and internationalisation, as well as the surrounding areas for planned large-scale projects. Even though large-scale projects are regionally nearby, for small entrepreneurs and micro-entrepreneurs those major projects are often difficult to participate in. This also applies to internationalisation. For this reason public business services are needed. Business providers are actors that are able to develop the needed skills of the entrepreneurs concerning large-scale projects and internationalisation. Providers see that one focus of future development will also be co-educational institutions. Recently graduated and entrepreneurship-oriented young people are not even necessarily fully aware of the available business services in the subregion.

Based on the interviews, one future development area of NIHAK is the awareness of the services among operating companies. Recently completed reform of the region's business services gathered under NIHAK has increased and clarified the public business services in the region. The threshold to be a customer of public business services has been lowered. Service network operates also thus that the other business service field operators guide customers to NIHAK. For example, start-up companies are directed to the desk of NIHAK by banks to refine their business ideas before applying for funding.

According to the interviews with service providers, feedback from customers has been mainly positive, which indicates that NIHAK has a successful service strategy. In general, those who use the public business services see the need, and those who do not use services criticize necessary of the services. The reason of negative feedback can be negative financing decision or regulatory barriers to business support. According to service providers, public business services are well-known in their area of operations, especially among the start-ups and early stage entrepreneurs.

Business service resources and competence are perceived to be reasonably good, especially in relation to the number of inhabitants and the firms in large cities, which often have better resources. However, additional staff resources could improve service efficiency, which could still further improve companies' growth potential. Based on the interviews, personnel's level of competence is perceived as good, especially since individuals' different competencies and strengths can successfully support each other in NIHAK. The maintenance of personnel´s competence is a horse race that requires constant updates. NIHAK tries to ensure necessary and continuous education and training of personnel, who consist of experienced professionals, many of whom have a business background. Experienced personnel are able to understand the companies' situations and to be customer-focused in all service implementations.

In the analysis between the industries, public business services' current challenge is the health care services sector, which is currently undergoing a major change. The industry is changing e.g. because of ePrescriptions and service vouchers. The task of public business services is to coach and prepare micro-companies to be able to operate and compete in concert with the new regulations and practices of the industry.

Survey results

When analysing the success and importance of the public business services, it is essential to gather information from the customers' perspective as well. Because of the large number of customers, survey research can provide us with a better picture of their opinions and experiences.

Table 5. General evaluation of NIHAK's business services on a scale from 1 to 5 (1= the weakest, 5= the most successful).

	n	1	2	3	4	5	mean
Contact person's knowledge and expertise	87	6	2	25	36	18	**3.67**
Smoothness and ease of cooperation	87	5	3	28	34	17	**3.63**
NIHAK's reputation in the region	85	7	7	32	27	12	**3.35**
Customer orientation	85	5	3	28	35	14	**3.59**
Operational flexibility	84	5	6	25	31	17	**3.58**
Operational efficiency	85	5	7	35	28	10	**3.36**
Operational quality	85	5	5	30	34	11	**3.48**
Continuous development of services.	83	5	5	31	32	10	**3.45**
Sum		43	38	237	257	109	**3.51**

According to the results (Table 5), customers consider different operations of NIHAK as reasonably good. The mean of all quality aspects of operations is 3.51 on a scale of 1 to 5. The most successful area of services is a contact person's knowledge and expertise (3.67). The weakest area among evaluated targets is NIHAK's reputation in the region, although the respondents' average estimate grade (3.35) is not poor. In general, survey data show that every evaluated area of service quality is successful, from the customers' perspective. In addition, all aspects are rated consistently by all customers without major differences.

Table 6 shows how customers evaluate the importance of business services and development activities provided by NIHAK for early-stage companies. According to Table 6, survey respondents consider customers before the establishment as the most important target group of the business services.

	n	1	2	3	4	5	mean
Before the establishment	104	5	7	13	27	52	**4.1**
Conception and development	104	3	8	21	35	37	**3.91**
Commercialisation	103	3	7	21	37	35	**3.91**
Expansion	103	3	8	22	38	32	**3.85**
Stability/ renewal	103	4	10	28	33	26	**3.66**
Sum		18	40	105	170	182	**3.89**

Table 6. Evaluation of the importance of public business services provided for early-stage companies (stage-by-stage), on a scale from 1 to 5 (1= the least, 5= the most).

Service activities done before a company's establishment are rated together as one group, and the mean is over 4. Half of the respondents argue that services done before the establishment are quite important; 50 % of the respondents rated them as a 5 on a scale from 1 to 5. It can also be noted that the importance of the public business services decreases stage-by-stage with the duration of the business.

Table 7 shows how customers evaluate the success of business services and development activities provided by NIHAK for early-stage companies. Services done before a company is established are the most successful, according to the respondents. The services done in the commercialisation and stability stages are rated as the least successful.

	n	1	2	3	4	5	mean
Before the establishment	58	4	6	16	19	13	**3.53**
Conception and development	54	3	7	21	16	7	**3.31**
Commercialisation	50	4	7	20	15	4	**3.16**
Expansion	51	5	5	21	12	8	**3.25**
Stability/ renewal	48	4	7	21	12	4	**3.1**
Sum		20	32	99	74	36	**3.27**

Table 7. Evaluation of the success of public business services provided for early-stage companies (stage-by-stage) on a scale from 1 to 5 (1= the least, 5 = the most).

In general, Table 7 shows that NIHAK has managed to provide quite successful services for companies in different stages of development. The customers´ point of view enhances providers´ understanding of their public business services.

According to the responses to open-ended questions in the terms of the demand and the importance of public business services, financial issues come up concerning the stage before a company's establishment. Balance of the finance is described as an important part of business planning. In the conception and development stage, networking, tax issues and cooperation with fund institutions are considered the most important affairs. In the terms of the commercialisation phase, respondents emphasised the necessity of services concerning marketing skills, target marketing and competition analysis. Based on the responses to open-ended questions, marketing, networking and internationalisation are seen to be the focal concerns of business services for SMEs in the expansion stage. Expertise services and consultancies are emphasised for stability/renewal stage companies, although public services are perceived a least important in this target group.

DISCUSSION

Public business services, especially for early-stage SMEs in the case area, were described based on interviews with providers in this study. In addition, the importance and success of the services were investigated based on these interviews and the survey addressed to customer companies.

Based on the case study interviews, it can be noted that when an entrepreneur with a business activity is a client of the business development services, that entrepreneur's enterprise is almost always in transition. In the positive or negative transitional stages, such entrepreneurs try to utilise public business development services. Grant applications and plans for extensions, projects and investments, as well as budgeting related to those plans, are typical services directed to enterprises engaged in positive transitions. One important function of business service organisations is to act as companions in discussions with entrepreneurs.

The organising of public business services in NIHAK can be described through three main characteristics. First, the services are organised through *important personal relationships*.

The relationship between business service managers and entrepreneurs is essential, as interacting with entrepreneurs on a personal level builds trust. This personalised approach includes responding to the needs of enterprises within a short time period, maintaining contact at least on an annual basis and tailoring services to make them entrepreneur-centred. Second, the *tailoring and productisation of services* is an integral part of the system. Most of the services are semi-structured, which offers the possibility to respond to the specific needs of each client. In addition to agencies' direct services, the services of the partner and network organisations are also offered. The productisation of services is important, especially when addressing the internal needs of the network and the partner organisations. To be able to tailor the services or to use the services of the network, business service managers have to know the existing service possibilities. Third, the services are organised through multiple *intermediary actors* with multiple roles. An organisation offering public business services in a rural area is acting on the interface. It is essential to produce and disseminate information to entrepreneurs, enterprises' staff and collaborating organisations. Agencies' role shifts based on the unique regional development tasks, such as promoting innovation possibilities and other preconditions of the enterprises.

Based on the interviews, several challenges were also pointed out such as internationalisation, attracting private financing and supporting SMEs' participation in the region's specific large-scale building projects (e.g. a nuclear power plant and an international underground physics research centre). Generally speaking, the service providers did not recognize major gaps between services and the needs of companies. They seem to have effectively utilized their networks and external expertise in cases of specific needs. On the other hand, some of them highlighted the need to build a more extensive knowledge base to be able to provide more accurate support for their customers.

The business service providers interviewed in this study emphasised the multi-skills needed of the business development managers so they can respond to local entrepreneurs' diverse needs. According to the survey, NIHAK's strategy has succeeded particularly in terms of personnel knowledge and expertise. Also, based on the survey results, personnel knowledge and expertise was rated as most successful dimension of services. Notable is that the importance of the services decreased towards the maturity stage of development. Thus, 50 % of respondents viewed services provided before a company's establishment as very meaningful, evidenced by their maximum rating of 5.

According to the customers´ responses regarding the general evaluation of NIHAK's business services on a scale from 1 to 5 (1= the weakest, 5= the most successful), it is notable that a rating of 1 was more common than 2. Therefore, it can be assumed that those who were not satisfied with the services were very disappointed. However, a significantly larger proportion of customers rated the services as a 4 or 5.

Based on the customers' responses, the most significant gap between the importance and success of services is in services in the commercialisation stage. A closer look at this gap can be taken by analysing answers to the open-ended questions concerning the commercialisation stage. The respondents see the need for guidance in marketing, financing and understanding the commercial competition at this stage. On the other hand, services for expansion stage companies have the smallest gap between the importance and success of the services. Nevertheless, respondents to the open-ended questions at this expansion stage see the need

for internationalisation services and marketing courses, as well as mentoring and networking services.

In future studies it would be interesting to investigate a larger number of cases with similar backgrounds. The results of this study represent the viewpoint of a public business service organisation and its customer companies in a sparsely populated area. Their viewpoints might differ from those of similar organisations in different business environments because of context-specific variables. It would be interesting to compare these findings to those of a similar analysis made in public business services located in rural areas in other European countries, in the US or in Asia.

ACKNOWLEDGEMENTS

This study is an essential part of the Entrepreneurship Research and Development of RDI in Oulu South Region project. The authors are grateful for the project funding supported by the Council of Oulu Region, the Kerttu Saalasti Foundation, the Nivala-Haapajärvi subregion, the Ylivieska subregion, the Haapavesi-Siikalatva subregion, the Central Ostrobothnian University of Applied Sciences, the Educational Municipal Federation JEDU and the European Regional Development Fund. We highly appreciate the organisations and persons involved in the study who shared their experiences.

REFERENCES

1. Blili, S., and Raymond, L. (1993), "Information technology: threats and opportunities for small and medium-sized enterprises", *Int J Inf Manage*, Vol. 13 No. 6 pp. 439–448.
2. Churchill, N.C., and Lewis, V.L. (1983), "The five stages of small business growth", *Harvard Business Review*, Vol. 61 No. 3, pp. 30–50.
3. Davidsson, P., and Wiklund, J. (2006), "3. Conceptual and empirical challenges in the study of firm growth", in Davidsson, P., Delmar, F. and Wiklund, J. (Eds): *Entrepreneurship and the Growth of Firms*, pp.39–61, Edward Elgar Publishing, Cheltenham.
4. Eurostat, (2012) *Regional Typologies Overview – Statistics Explained* (2013/2/6) <http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Regional_typologies_overview>
5. Greiner, L. (1972), "Evolution and revolution as organisations grow", *Harvard Business Review*, Vol. 50 No. 4, pp. 37–46.
6. Ministry of Employment and the Economy. (2012), Public Business Services in Regions. *Publications of the Ministry of Employment and the Economy* 45/2012. Helsinki, Ministry of Employment and the Economy. (in Finnish: Julkiset yrityspalvelut alueilla)
7. Muhos, M. (2011). Early Stages of Technology Intensive Companies, Acta Universitatis Ouluensis, C 381, University of Oulu.
8. Muhos, M., Kess, P., Phusavat, K., and Sanpanich, S. (2010), "Business growth models: review of past 60 years", *International Journal of Management and Enterprise Development,* Vol. 8 No. 3, pp. 296–315.
9. Muhos M., Kess P., Distanont A., Phusavat K., & Sanpanich S. (201n), "Early stages of technology-intensive companies in Thailand and Finland" *Int J Economics and Business Research* X(Y): xxx-xxx (in press).

10. Stathopoulou, S., Psaltopoulos, D., and Skuras, D. (2004), "Rural entrepreneurship in Europe: a research framework and agenda", *International Journal of Entrepreneurial Behaviour & Research,* Vol. 10 No. 6, pp. 404–425.
11. Tagliavini, M., Ravarini, A., and Antonelli, A. (2001), "An evaluation model for electronic commerce activities within SMEs", *Information Technology and Management*, Vol. 2 No. 2, pp. 211–230.
12. Veugelers, R., Aiginger, K., Breznitz, D., Edquist, C., Murray, G., Ottaviano, G., Hyytinen, A., Kangasharju, A., Ketokivi, M., Luukkonen, T., Maliranta, M., Maula, M., Okko, P., Rouvinen, P., Sotarauta, M., Tanayama, T., Toivanen, O., and Ylä-Anttila, P. (2009), *Evaluation of the Finnish National Innovation System – Full Report*. Helsinki: Taloustieto Oy.
13. Wiklund, J. (1998), Small Firm Growth and Performance: Entrepreneurship and Beyond, Dissertation, Jönköping University, Jönköping International Business School, Jönköping.
14. Yifeng, X. (2011), "Open innovation of small and medium sized enterprises and R & D public service platform: a case about the VIC model of Zhangjiang Hi-tech Park", *E-Business and E-Government (ICEE)*, 2011 International Conference on. , IEEE: 1–4.
15. Yin, R. K. (1994), *Case Study Research: Design and Methods*. Thousand Oaks, CA, Sage Publications.

BIOGRAPHICAL

Martti Saarela is a Researcher at the Oulu Southern Institute at the University of Oulu. He has a Master of Science in Economics. His primary research interests are finance, stock markets, the development of micro-companies and SMEs in rural areas and regional development. Because of his law student background, his particular research perspective is law and juridical environment. In recent years Saarela has been involved in many projects in the area of regional development.

Eija-Riitta Niinikoski is a Development Manager at the Oulu Southern Institute at the University of Oulu. She has a Master of Arts in Theology. Her primary research interests are regional development, the role of higher education institutions in regional development, internationalisation processes and the development of micro-companies and SMEs in rural areas, and management and leadership of expert organizations. Niinikoski has been the manager responsible for many development projects; she has also been involved in several international projects.

Dr. Matti Muhos is a Research Director at the Oulu Southern Institute at the University of Oulu. He holds a Doctorate in Industrial Engineering and Management. He participates in the editorial processes of several international journals as an associate editor, quest editor and advisory board member. His primary research interests are growth and the internationalisation of technology intensive SMEs including configurations and management viewpoints, the development of micro-companies and SMEs, technology intensive companies, agility, internationalisation processes and technology management. He has worked on several international projects and has written more than 60 publications in the forms of journal papers, book contributions, refereed conference papers and technical papers.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

AN INTEGRATED OPTIMIZATION MODEL FOR DISTRIBUTION CENTER LOCATION WITH CONSIDERATIONS OF POPULATION AND INCOME

Aditi Dwivedi, Department of Industrial and Systems Engineering
Ohio University, Athens, Ohio 45701

Namkyu Park, Department of Industrial and Systems Engineering
Ohio University, Athens, Ohio 45701
parkn@ohio.edu

ABSTRACT

This paper uses optimization technique and decision making method to find the optimum location for a group of distribution centers. Two levels of distribution center location have been found out. The first level uses set covering methodology to obtain the location which is the location for regional distribution center. The second level uses Analytical Hierarchy Process to obtain the location which is the location for local distribution center. This problem finds the location for two levels of distribution center for the state of Ohio considering various factors and conditions, primarily focusing on population and income.

Keywords: Two levels of distribution center location problem, location problem with population and income considerations

INTRODUCTION

Many models have been developed for the design of distribution center location which has provided valuable information about location problems, but this research offers a unique discernment for solving location problems as a completely distinct approach has been adopted. In this thesis, a multi-product single manufacturing facility is assumed. This facility wants to have two levels of distribution centers (DC); 1) Regional DCs (RDCs) 2) Local DCs (LDCs). The location of RDC is found out using set covering methodology and the location of LDC is found out using Analytical Hierarchy Process (AHP). A new modified model from the original model has been developed for set covering and AHP. Then some extension to both the models also has been discussed and evaluated. Set covering is a facility location problem which helps in determining the minimum number of facilities to cover maximum demand. The set covering formulation is given as [1]:

$$\textit{Minimize } z = \sum_{j=1}^{n} C_j X_j \qquad (1)$$

$$\text{Subject to} \quad \sum_{j=1}^{n} a_{ij}X_j \geq 1,\ i = 1 \ldots m \qquad (2)$$

$$X_j = \{0, 1\},\ j = 1, \ldots\ldots, n \qquad (3)$$

Analytical Hierarchy Process is a decision making tool to solve multi-level hierarchical problems. It was introduced by Saaty [2]. The AHP divides the problem in picture into three levels [3]:

1) Define a goal for resolving the problem.
2) Define objectives for achieving the goal.
3) Determine evaluation criteria for each objective.

This research consists of two levels of distribution center, one at regional level and other at local level. The inspiration to have such a kind of system for distribution center was inspired by the theoretical concept of hub and spoke system. The very basic hub and spoke model is used as a prototype for the distribution network which is the most important part of this research work. A pure hub and spoke system consists of a hub and many spokes [4]. A hub usually performs activities like reassembling, and redirecting parts [4]. Spokes act as a connection between customers and hub [4]. In this research, for the first level of distribution system the manufacturing center is acting as a hub and RDC is acting as a spoke. For the second level of Distribution system the RDC is acting as a Hub and LDC is acting as a spoke.

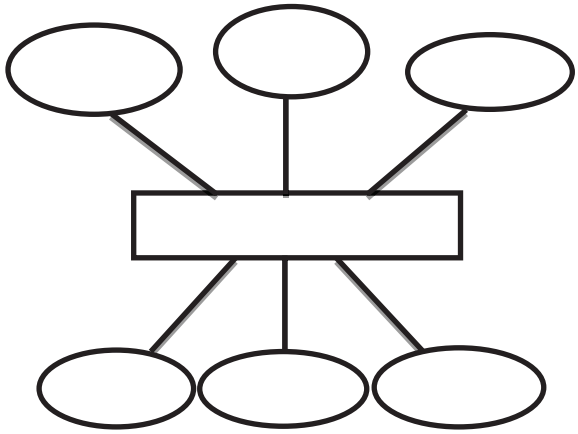


Figure 1: Hub and Spoke for the first level of distribution system

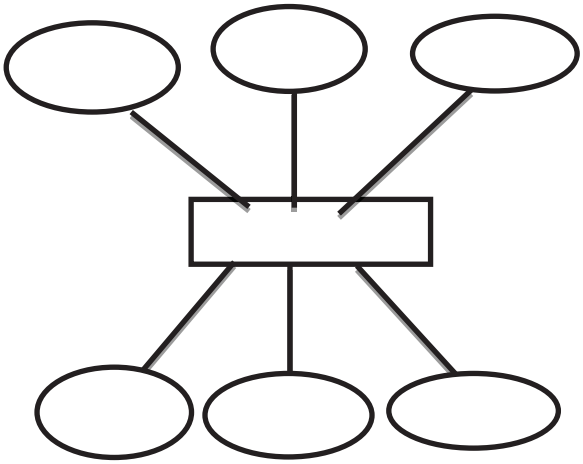


Figure 2: Hub and Spoke for the second level of distribution system

1. Objective

The main objective of this research is to determine two levels of distribution centers, one at regional level and the other at local level. The local distribution center (LDC) will assist regional distribution center (RDC) and will be located around the RDC. This problem is specifically a location and a selection problem where location of distribution centers and their number will be decided. This problem is inspired by a food company located in Jackson, Ohio which was looking to locate certain number of distribution centers nationwide, but this problem is limited to only in the state of Ohio.

2. Background

The two level arrangement of distribution center is usually observed in many distribution networks like a hub and spoke system where the mail is sent to some centralized system, and then from there they are dispatched to their destinations [5]. This type of system has been successfully implemented in the airline industry [5] and in various logistics network [4]. Big Corporations, like FedEx, have also implemented Hub and spoke type of model because of the various advantages that it has to offer [5].

Set covering focuses on covering all the demand with a minimum number of sites [1].Since the problem in this research is to cover the maximum area possible, set covering was thought to be an effective method, as this method assumes that there is some critical coverage distance or time within which demands need to be taken care of if they are counted as covered [1]. Set covering has numerous applications such as in locating emergency facilities, school, police station, distribution center etc. The location models are characterized into four types and one of them is discrete model[6]. Under discrete location model there are three more categories and one of the categories is Covering based models [6]. The covering based model is further divided into set covering, max covering and P-center [6]. Out of the three covering based models we are using

set covering model in this thesis which covers all the demands with minimum number of sites [6].

AHP is used for decision making in engineering applications, where both the quantitative and qualitative factors are taken into account and decision is made after evaluating a number of pertinent criteria [7]. The idea of using AHP for making decision for DC location came from the paper by Saaty [8]. The author describes AHP as a theory of measurement through pairwise comparisons and based on judgments [8]. According to the author it's the best tool for decision making. The ranking system for preference scale has been taken from this paper specifically. There are many papers on AHP using different preference scale, but the preference scale used in this paper has been used as Saaty has proved the validity of this scale in his paper.

Few studies have combined set covering and AHP to improve solutions. This research will use a unique approach to combine AHP and set covering to decide the best location of distribution center. The approach in this research is different from traditional approaches where either of the method is used to improve the solution, like in the research paper by Hwang, where public facility is located first by using AHP approach and then to improve this solution set covering is used [9]. However, in this research set covering will make sure that first whole region is covered and AHP will make sure that a certain region is covered.

3. Reasoning Behind The Three Way Methodology

The food company sells certain kinds of products which are affordable by all income groups. The Product line which is affordable can still be categorized in three income level groups. The categorization of the food products is a assumption for this research purpose.

a) Low priced products: These types of products are used by the lowest income group. The middle income can use these types of products and the highest level income may not use these types of products at all.

b) Mid-range priced products: The specialty of these types of products is that it can be used by all income groups.

c) High priced products: These types of products are usually used by high income groups.

For our research problem we will be dealing with Mid-range priced products which can be sold in each and every region and to all income groups. The following are the reasons for adopting the three way methodology for these types of problems:
1) Since we are dealing with mid-range price products which are affordable by all the income groups, therefore it is taken into consideration that such products can be sold in each and every region and so this reason forms the basis of clustering the Ohio state based on directions, so that a group of counties lies in the same direction.
2) Since in this research we are trying to sell mid-range priced products, which can be sold in every region, set covering is applied which will make sure that each and every region is covered

3) AHP is applied to locate LDCs around each RDC, since the coverage has already been taken care by set covering there may be other criteria which are required to be considered while setting up LDCs around each RDCs like cost, labor, distance so that not only every region is covered but certain conditions are also satisfied while setting up LDC taking local factors and characteristics into account.

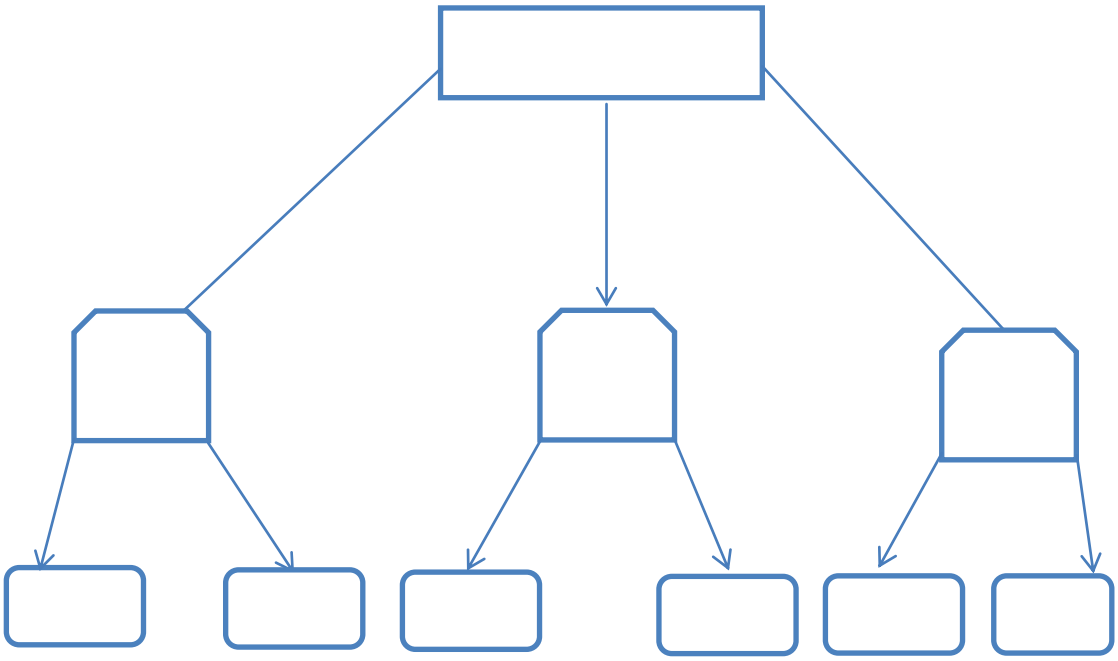


Figure 3: Hierarchical representation of the problem.

METHODOLOGY

The following methods will be adopted to solve this problem. The methods are summarized in the following steps:
1) The two level hierarchy of distribution center is inspired by hub and spoke model. The regional distribution center and local distribution center consists of two level of distribution center.
2) The very first step would be to divide the state of Ohio into certain number of regions based on geographic directions and population.
3) The Step # 2 will divide the state of Ohio into some number of regions.
4) After regional division, set covering methodology would be applied to locate a RDC in each of these regions.
5) Once the location of RDC is determined, the next step would be to determine some number of LDC around each of RDC using AHP.
6) The methodology can be described in more detail in the following way:

a) The map of Ohio state is used for this research purpose which is divided into counties. Regional division is done for the map.
b) The state of Ohio is divided in such a way that each region has a population range between 1.5 million to 3 million as it is assumed that each RDC or group of RDCs can serve at the most population in the above defined range.
c) The regional division is done based on population and considering adjacent counties and nearby counties. If the population for a group of counties together lies in the range between 1.5-3 million then that group forms one region.
d) After the regional division, set covering is used in that particular region to find RDC or groups of RDC. Population, income and distance are the deciding factors to obtain the location of RDC which is incorporated in the set covering formula.
e) After obtaining the location for RDC, LDC is found out using AHP technique which will be the interface between RDC and customers. Various factors are taken into consideration while solving AHP.

1. Formulation

Set covering formulation: The new set covering Formulation was derived. The formulation is as follows:

$$Minimize\ z = \sum_{j=1}^{n} F_{ij}X_j + \sum_{j=1}^{n} C_jX_j \qquad (1)$$

$$Subject\ to \quad \sum_{j=1}^{n} P_{kj}X_j + \sum_{j=1}^{n} I_{kj}X_j + \sum_{j=1}^{n} D_{kj}X_j \geq 1, \qquad (2)$$

$$k = 1..m$$

$$X_j = \{0, 1\}, j=1, ..., n \qquad (3)$$

Equation (1) minimizes the total cost.

Equation (2) describes the constraints. These constraints make sure that each of the counties is at least covered by one occupied county where RDC will be located.

Equation (3) is the decision variable which takes the value 1 or 0.

If a county is satisfying a given condition, which is also a potential RDC site then its value will be 1 else 0 where

F_{ij} : (Distance × Cost required needed to cover that distance). The distance would be from manufacturing facility to potential RDC site. Thus F_{ij} is basically the cost associated

to cover the distance between manufacturing facilities located in Jackson to the potential RDC site. This is a fixed cost and not a one-time cost.

C_j : The fixed cost associated to operate the RDC. This cost is also not a one-time cost. The cost may include electricity cost, labor cost, taxes, maintenance cost etc.

i : Manufacturing Site

j : Potential Distribution Center location

The explanation for equation (2) is explained below:

$$\sum_{j=1}^{n} P_{kj}X_j \; + \sum_{j=1}^{n} I_{kj}X_j \; + \sum_{j=1}^{n} D_{kj}X_j \; \geq \; 1,$$

$$k = 1..m$$

k: county
j: potential RDC site

Here, P is population of the county k that can be covered by potential distribution center j if a condition is satisfied. Conditions for different regions will be different. Here the county itself is the potential RDC site too. Therefore k and j both are counties except for the fact that j is the county which will be acting as a potential RDC site.

If population lies within a certain range for the particular region then the condition will be satisfied if

$$\underline{P_{kj}} = 1$$
Else
$$\underline{P_{kj}} = 0$$

I is Income of county k such that the income lies within a certain range so that it can be covered by potential distribution center j. Conditions for different regions will be different. Here the county itself is the potential RDC site too. Therefore k and j both are counties except for the fact that j is the county which will be acting as a potential RDC site.

If the income lies within a certain range for the particular region,

then $I_{kj} = 1$
Else
$I_{kj} = 0$

D is the distance between a county k and potential distribution center j such that the distance lies within a certain range so that it can be covered by potential distribution center j. Conditions for

different regions will be different. Here the county itself is the potential RDC site too. Therefore *k* and *j* both are counties except for the fact that *j* is the county which will be acting as a potential RDC site.

If the distance lies within a certain range,

then $D_{kj} = 1$
Else
$D_{kj} = 0$

1) Analytical Hierarchy Process: The hierarchical diagram is created in this process.

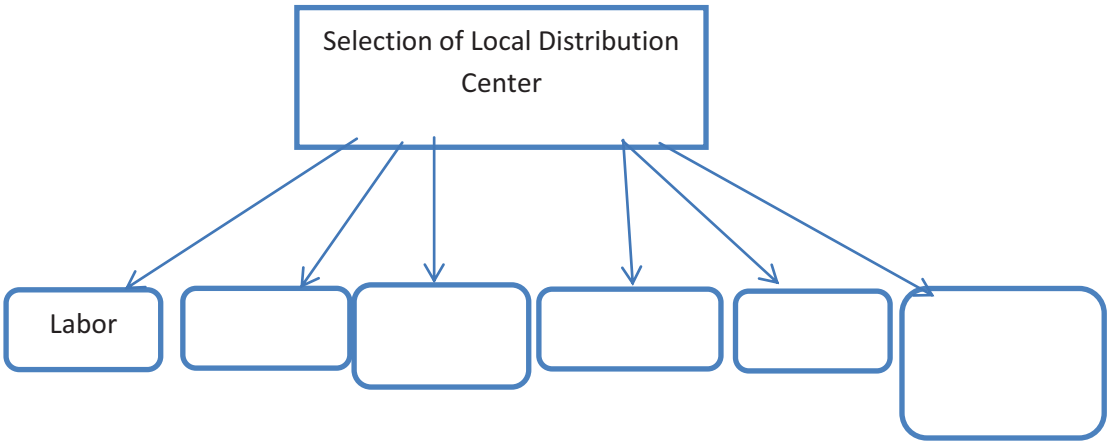


Figure 4: Criteria Level Representation

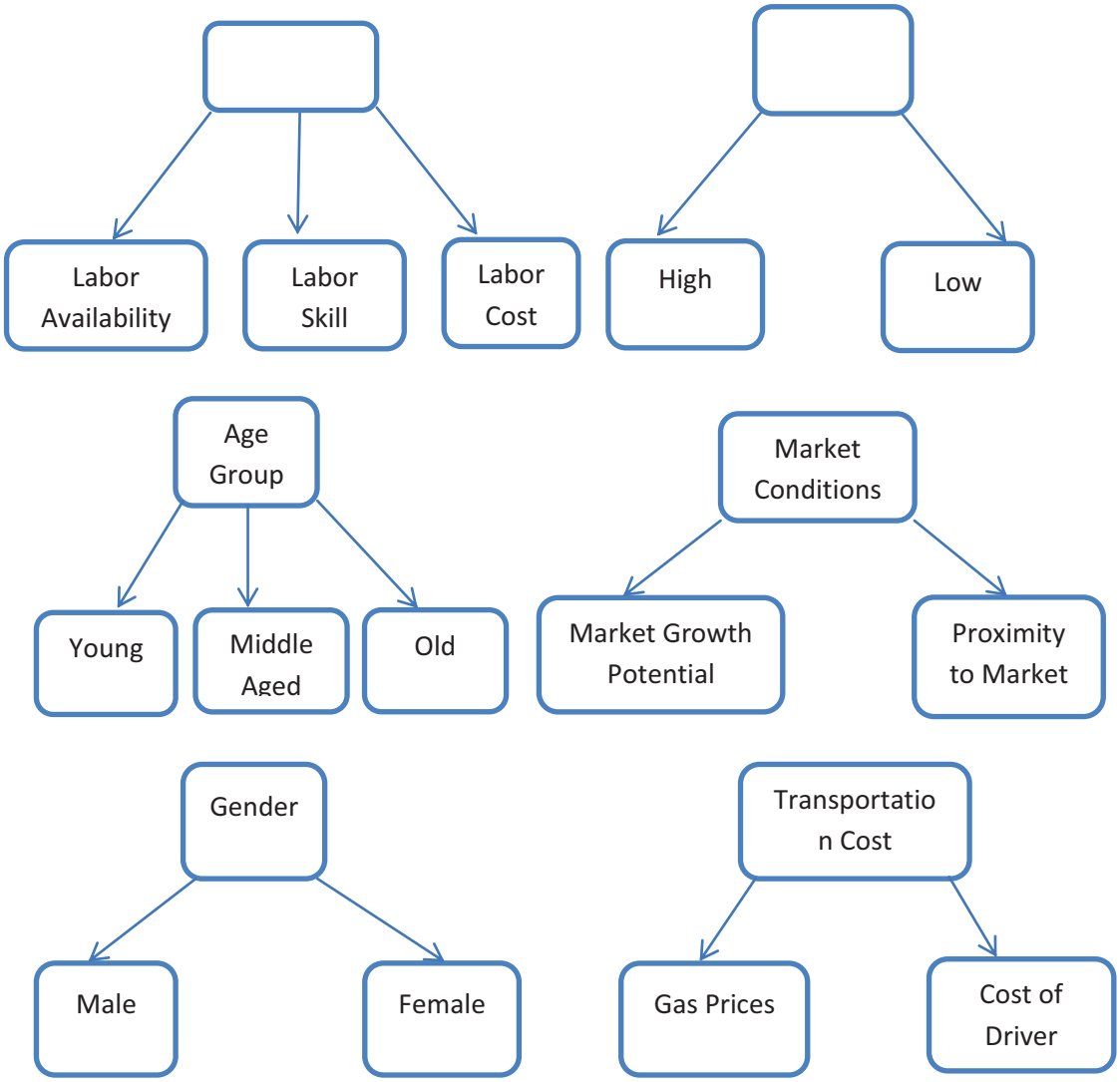


Figure 5: Sub-Criteria Level Representation.

The following steps will be implemented to solve AHP:

a) Calculate weight for each criteria w.r.t each DC and then calculate final composite rank for each of the DC's.
b) Calculate weight for each sub-criteria w.r.t each DC and then calculate final composite rank for each of the DC's.
c) Add the composite scores for criteria and sub criteria level to get the final rankings for the LDC
d) Add the composite scores for criteria and sub criteria level to get the final rankings for the LDC.

2. Extension for set covering model

The new set covering formulation can still be modified to have one more additional constraint

$$Minimize\ z = \sum_{j=1}^{n} F_{ij}X_j + \sum_{j=1}^{n} C_jX_j \quad (1)$$

$$Subject\ to \quad \sum_{j=1}^{n} P_{kj}X_j + \sum_{j=1}^{n} I_{kj}X_j + \sum_{j=1}^{n} D_{kj}X_j + \sum_{j=1}^{n} M_{kj}X_j \geq 1 \quad (2)$$

$$k=1 \ldots m \quad (3)$$

$$X_j = \{0, 1\}, j=1, \ldots\ldots, n$$

As can be seen in equation (2), a new constraint was introduced M_{kj} which is market conditions.

The data was obtained for the following:

a) Investment climate
b) Number of business starts
c) New & Expanding facilities.

The data for the above three information were combined together to obtain the final Market condition situation for each of the county. The above mentioned data was obtained for each of the counties from Ohio Department of development website[10].

3. Weight Based Set Cover Model

The formulation will be modified to the following:

$$Minimize\ z = \sum_{j=1}^{n} F_{ij}X_j + \sum_{j=1}^{n} C_jX_j$$

$$Subject\ to \quad w1 * \sum_{j=1}^{n} P_{kj}X_j + w2 * \sum_{j=1}^{n} I_{kj}X_j + w3 * \sum_{j=1}^{n} D_{kj}X_j + w4 * \sum_{j=1}^{n} M_{kj}X_j \geq 1$$

$k = 1, \ldots\ldots, m$

$X_j = \{0, 1\}, j=1, \ldots\ldots, n$

where w1+w2+w3+w4=1

w1, w2, w3, w4: weights allotted to each of the constraint.

4. Extended AHP Model:

The three extended models are developed for AHP, they are:

1) Model 1: Multiplying weights for criteria, sub-criterion and county w.r.t sub-criterion to obtain final composite scores for each region.
2) Model 2: Adding the weights for each county w.r.t sub-criterion to obtain the final ranking in each region.
3) Model 3: Add the composite scores for criteria and sub-criteria to obtain the final ranking.

RESULT

The map of Ohio is shown below with all the eighty eight counties and division into five regions after the regional division. The counties in red are RDC and the counties in yellow are LDC for that particular region. The location for RDC and LDC are obtained after solving the set covering and AHP formulation in section 2.1.

The following conclusions can be drawn from the results obtained by solving different set cover models:

The answers obtained by the new model and the model consisting of M_{kj} constraint gave more or less the same answer. However, when weights were introduced the answers differed to some extent from the previous two models.

The following conclusion can be drawn after solving four different AHP models

1) The answers obtained by the AHP model and Model 1 are to some extent similar, though not completely.
2) The answer given by Model 2 largely differs from the AHP model and Model 1. The county location obtained seems to be unreasonable as the locations are almost near to each other which won't be able to cover the complete region.
3) The answer given by Model 4 is different from all the models.

REFERENCES

1. Tompkins, J.A., 2010, *Facilities planning*,Wiley.
2. Saaty, T. L., 1994, "How to make a Decision: The Analytic Hierarchy Process," *Interfaces*, pp. 19-43.
3. Chakraborty, T., Ghosh, T., and Dan, P. K., 2011, "Application of Analytic Hierarchy Process and Heuristic Algorithm in Solving Vendor Selection Problem," *Business Intelligence Journal*, 4(1).
4. o Ekárt, A., Buckingham, C., and Welch, P. G., 2011, *Multiple-participant Hub-and Spoke logistics networks: Challenges, solutions and limits*.
5. Brueckner, J. K., and Zhang, Y., 2001, "A Model of Scheduling in Airline Networks: How a Hub-and-Spoke System Affects Flight Frequency, Fares and Welfare," *Journal of Transport Economics and Policy* (JTEP), 35(2) pp. 195-222.
6. Daskin, M. S., 2008, "What You should Know about Location Modeling," *Naval Research Logistics (NRL)*, 55(4) pp. 283-294.
7. Triantaphyllou, E., and Mann, S. H., 1995, "Using the Analytic Hierarchy Process for Decision Making in Engineering Applications: Some Challenges," *International Journal of Industrial Engineering: Applications and Practice*, 2(1) pp. 35-44.
8. Saaty, T. L., 2008, "Decision Making with the Analytic Hierarchy Process," *International Journal of Services Sciences*, 1(1) pp. 83-98.
9. Hwang, H. S., "*Public service facility planning based on GIS*"
10. Ohio Department of Development, Policy Research and Strategic Planning June 2011, http://ohio.gov/.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

SAFETY CULTURE MATURITY IN UPSTREAM: OIL AND GAS INDUSTRY IN THAILAND

Bordin Vongvitayapirom, Engineer, Performance Analysis, PTT Exploration and Production Public Company Limited, Faculty of Engineering, Kasetsart University
bordinv@pttep.com

Dr.Kongkiti Phusavat, Associate Professor, Faculty of Engineering, Kasetsart University,
fengkkp@ku.ac.th

ABSTRACT

The demand of energy in Thailand has significantly increased for the past 10 years. Volunteer company as one of the subsidiary company of Thailand National Oil and Gas Company, has responsible to respond to serve country's energy demand in order to minimize import expense. Upstream Business Company like volunteer company is responsible to find the natural resources and energy to supply the country demand. Company is also in High-risk industry which one major accident may result operation disruption and impact to the country e.g. gas supply shortage to power plant and cause electricity shortage in Thailand. On the other hand, it may cause major reputation damage, multiple fatalities, environment contamination and financial loss to company and society. Hence, safety is one of the most important areas to make sure operation run smooth and prevent those from happening. The evolution and focus of safety have improved from 1980s, 2000s to early 2010s in Technology, System and Culture areas respectively. In Thailand, safety culture is very new and many companies fail to create the effective safety culture. Volunteer company has focused on safety culture (people) from the past 5 years due to root/underlying causes of the incident come from human factor. Volunteer company tailor made safety culture maturity model of 5 levels, Pathological, Reactive, Calculative, Proactive and Generative, from industry best practice along with strengthens safety management system in order to reduce incident and prevent Major accident in operation. Volunteer company launched safety culture questionnaire to identify company status to all employee in 2011 and result come with they are in level 3 (Calculative). Once the safety culture level has been clarify, it is easier to use proper tools and techniques to create a culture change, Volunteer company come up with 5 years roadmap to create a culture change from 2011 – 2015 with aspiration to achieve Generative level. As result of Volunteer company safety culture improvement shown indirectly from reduction in "Lost time injury frequency" (LTIF) and "Total recordable injury rate" (TRIR) from safety statistics, severity of the case has been reduced and operation run smoothly without any major accident.

INTRODUCTION

From 2009 – 2011, the overall Thailand energy consumption (Petroleum products, Natural gas, Coal, Lignite and etc) was higher than country production. Hence, Government has to import them and related product to meet the demand which increasing rapidly for instance only one-third of hydrocarbons demand satisfied by domestic resources (Department of Mineral Fuels, 2011) In past decade, Thailand boost production capacity of its already strong manufacturing section particularly heavy industries, including auto manufacturing, metalworking and petrochemicals factories. Those require substantial amounts of energy, which far exceed what country can produce (The report Thailand, 2012). Moreover In 2011, Thailand oil and gas consumption is ranked 19th and 25th among overall country or 1.2 % and 1.1% respectively of the world consumption which higher than neighbor country (BP, 2011). In 2013, Thai government concerns about energy consumption and promotes energy saving campaign in order to prevent electric shortage on April which is the highest rate of electricity usage in year round. They concern that there might not be enough gas to supply power plant due to annual maintenance of major gas supply sources from international country in the same period of time. There are many national and international companies e.g. Chevron, BG, PTT Group and Total investing Oil and Gas business in Thailand for instance, exploration and production in gulf of Thailand and Andaman sea, Refinery in Rayong province and Marine base in Songkla province. Volunteer company, a national Oil and Gas Exploration and Production Company (Upstream) subsidiary of PTT Group, play an important role and responsible to find energy sources from domestic and international to serve country's energy demand. If there are any major incidents in Volunteer company operation for instance explosion in well head platform, major leak or corrosive in 32" pipeline may cause unplanned shutdown and delay in energy supply to production source. One of those outcomes are electricity shortage which impact many stakeholders in Thailand for example; Automobile industry may need to lower production, higher price of Oil and Gas which cause general product more expensive and cut electricity in some area. As the result of, Oil and Gas industries especially upstream in Thailand are continued to expand to sustain country demand in future.

Table.1. Energy, inputs and consumption from 2009 – 2011 (BOI, 2012)

Energy consumption ('000 bpd)	2009	2010	2011
Production	849.8	989.2	1017.5
Import (net)	922.0	1000.6	1016.5
Consumption	1662.6	1782.9	1845.5

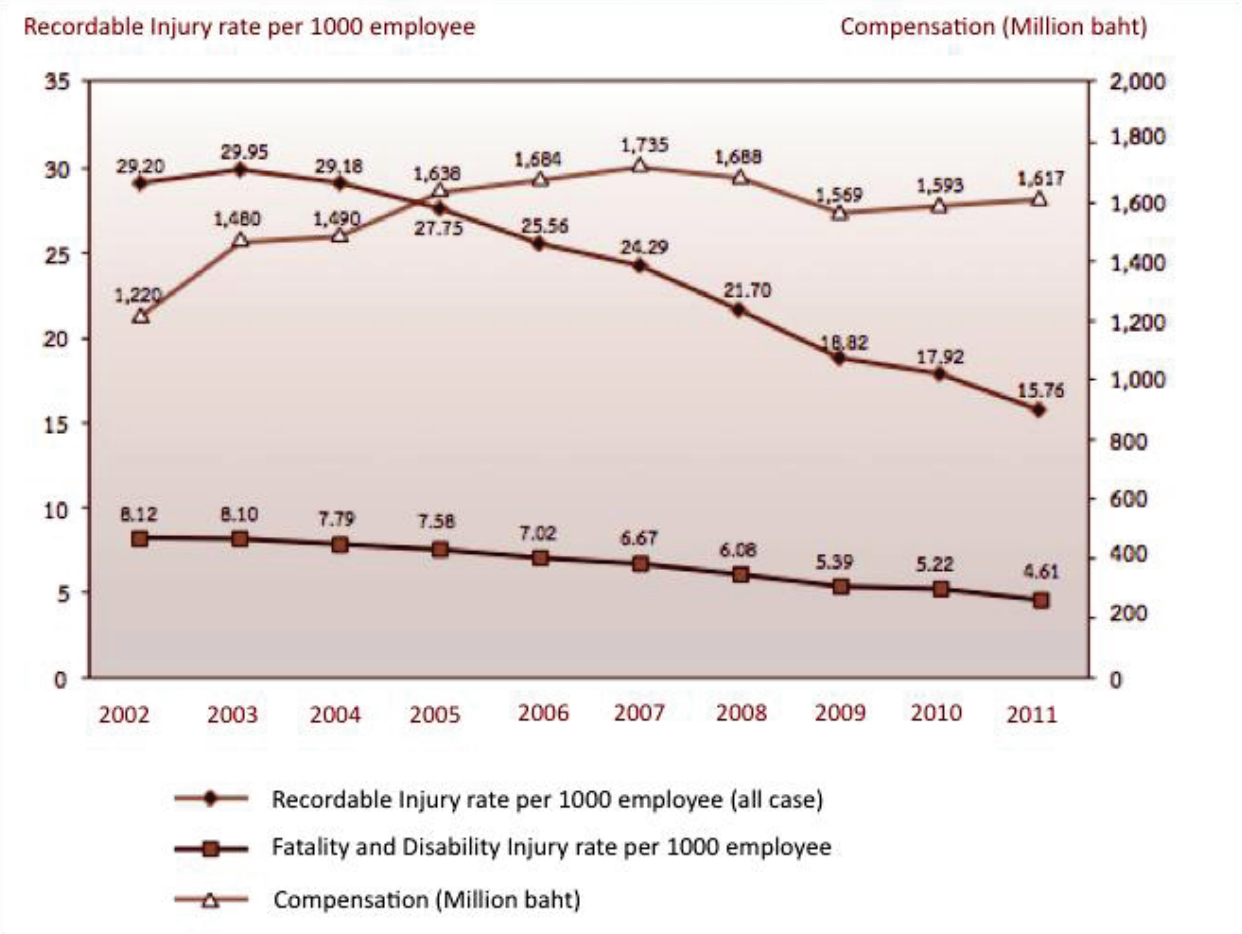


Table.2. Recordable injury rate vs Compensation of Thai Employee (Ministry of Labour, 2012)

In broad industry, accident injury trend in Thailand has reduced from 29.20 in 2002 to 15.76 in 2011 but the compensation has increased from 1,220 to 1,617 million baht as the severity of the accident increased e.g. fatality, disability and lost work day case. Thus, injured employee can claim the compensation with government agency as one of the law requirement. One of the reasons the compensation is high because government agency cannot control the large scale accident and government management (public sector) responsible area divide into province, district and sub-district level. Moreover, they have overlapping responsible area and office of their own with complicate hierarchy system. When large scale accident happen e.g. Refinery explosion, Major oil and gas leak and terrorism, government (public sector) cannot immediate respond and communication has been complicated. Thus, injury severity has unnecessary increased with higher the injury claim compensation. As the result, public sector cannot respond to medium to large-scale accident on time and making the company to rely on their own safety, risk and crisis management system and coordinate with other organization in their neighborhood in order to mitigate the incident which may be escalated.

There are many study of safety culture for high-risk industry e.g. nuclear, aviator and petrochemical in Europe, America and Middle East. On the other hand in Thailand, There is no theoretical or empirical for safety culture in Oil and Gas Company in Thailand and yet safety

culture still new in this country. In 1980s (table.3), the first approach (technique) for organization to reduce their accident rate by developing technology such as hardware and design to keep hazard away and prevent employee from entering the line of fire. Second is system approach, when technology is well implement in organization, which has been focused in early year of 2000 to improve employee capability using knowledge and training, conduct risk assessment, Plan Do Check Act (PDCA) by Deming and implement management system such as ISO: 9001, ILO-OSH 2001 and OHSAS: 18001. Organization using the standard and certificate as a business competitiveness as the number of certified company is increasing each year as more than 1.2 million certification of ISO 9001 and 14001 worldwide (ISO, 2009). On the contrary accident still happens to organization that improves their technology, hardware, compliance, competency using technology and system approach. Organization can control the safety equipment, engineering design; competency of employee and management system but culture and behavior cannot be controlled. The third is culture approach that focuses on leadership, safety attitudes and people.

Compare to Thailand industry, in 1980-90s, Occupational health and safety were not significant to production and quality since many industries aimed to maintain highest productivity as much as possible and the legislation was not fully enforcement by the government in term of safety management system. On-site improvement of engineering design, operating equipment and personal protective equipment (technology) were adopted in early age of Thailand industry. In 1999, government issued the first safety management system named “Thailand Industrial Standard (TIS:18001)” which referred BS880:1996 and BS OSHAS:18001. As result of Thailand incident trend were downward since 2003 but compensation rate was vice versa shown that only technology and system were not enough. Hence, improvement on safety culture in Thailand industry is needed in order to improve organizational behavior toward safety and accountability to individual work.

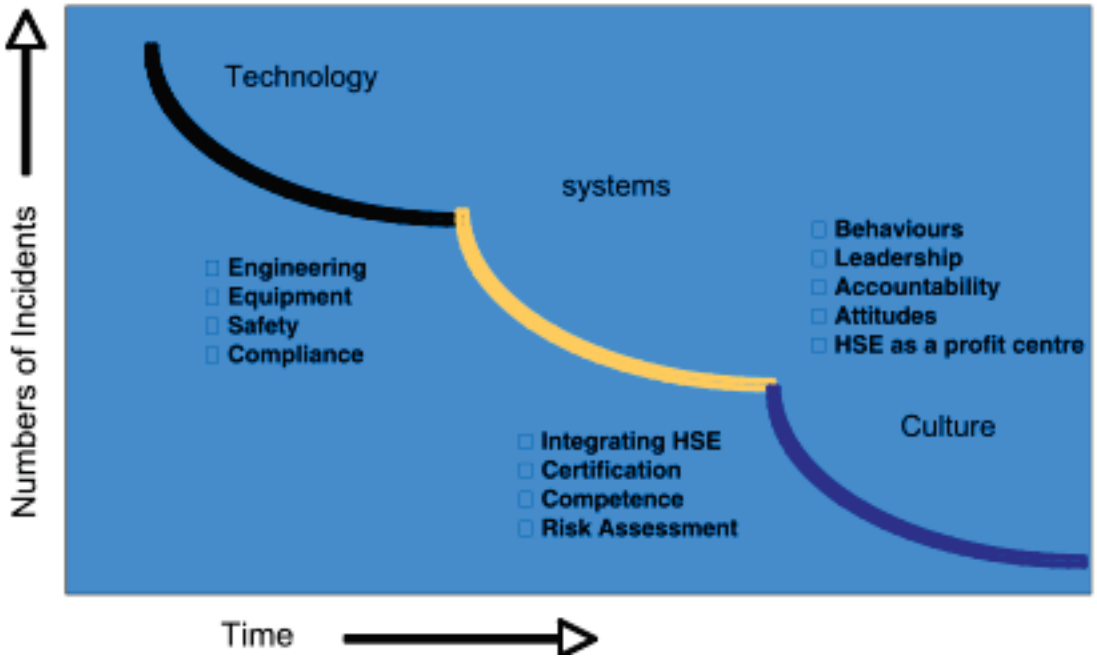


Table.3. Developmental line, culture becomes the next wave after system safety (Hudson, 2007)

The word "Safety culture" is originated after the Chernobyl disaster, nuclear industry, in 1986 as the behavior of employee can impact the outcome of safety performance (Flin et al. 2000). Failure to implement and sustain high level of safety performance in high-risk industry can cause disaster to their company, environment, and neighbor. In oil and gas industry, safety culture has been concerned since Piper Alpha disaster, which the consequence of the accident caused; company both reputation and financial damage in long term. In 2009 there were Montara accident, PTTEPAA, caused large contaminate to the environment, marine and wildlife. Moreover in 2010, there were Macondo in the Gulf of Mexico, BP failure from lesson learnt from Texas refinery accident in 2005 (15 fatality and more than 150 employee injured), which failure in process safety and human error can caused major accident event (MAE) as result of 11 men died and 17 injured, one of the largest oil spill in the history to environment, impact to social around the area and more than $17.7 billion have been spent on many years of response activity (BP, 2010). Those accident root causes come from poor safety culture & human error, cost cutting, integrity and reliability, core competency and wrong decision-making.

There are many definition of safety culture as the following;

- Safety culture has been described as the collective values and attitudes of the people in the organization; "It is the way we do things around here" (Changing mind, 2000).
- Safety culture can be simply defined as the attitudes, values and beliefs that underpin "the way we do things here" (OGP, 2010)
- The safety culture of an organization is the product of individual and group values, attitudes, competencies and patterns of behavior that determined the commitment to, and the style and proficiency of, an organization's health and safety performance. (ACSNI, 1993)

Reason (1997, 2007) also proposed that an organization with an effective safety culture: has systematic safety information, reporting culture, culture of trust among people, organization flexibility and willingness and competence to draw the right conclusions from its safety system. Reason also identified safety culture characteristics, which are;

- An informed culture-one in which those who manage and operate the system have current knowledge about the human, technical, organizational and environmental factors that determine the safety of the system as a whole,
- A reporting culture; a culture in which people are willing to report errors and near misses,
- A just culture; a culture of "no blame" where an atmosphere of trust is present and people are encouraged or even rewarded for providing essential safety-related information- but where there is also a clear line between acceptable and unacceptable behaviour and,
- A flexible culture which can take different forms but is characterized as shifting from the conventional hierarchical mode to a flatter professional structure.
- A learning culture – the willingness and the competence to draw the right conclusions from its safety information system, and the will to implement major reforms when the need is indicated

To identify and measure safety culture in organization safety climate is one of the tools which Flin (2001) mentions that safety climate can be regarded as a predicator for safety performance.

Safety culture impact both directly and indirectly to improve safety performance for instance, employees concern their safety and others may result in less lost time injury (LTI) and total recordable injury (TRI) in operation, poor quality inspection pass due to "it should be alright" or bad culture will be less as result of better process safety performance e.g. less fire and explosion. There are many researchers and organization implement safety culture model in order to improve safety performance. In this paper, safety culture framework and associate dimension for case study will discuss later part of the paper. In each model, there are dimension and organizational aspect shown in following table;

Table.4 Example of safety culture model, dimension and organizational aspect

Safety culture model by	Safety culture dimension/Organizational Aspect
Kao, C. S. (2008)	Safety Commitment and support, Safety attitude and behavior, Safety communication and involvement, Safety training and Competence, Safety supervision and audit, Safety Management system and organization, Accident investigation and emergency planning, Reward and punishment and benefit
Filho, A.P.G (2010)	Information, Organization learning, Involvement, Communication, Commitment
Lawrie, M (2006)	Commitment to HSE and care for colleagues, Balance between HSE and profitability, Workforce interest in competency and training, Work-site job safety techniques, Purpose of procedures, Repercussion and feedback after accidents, audit and reviews
Jirisuka (TMAP-EM, 2011)	Organizational for S&H management, S&H action plan, Implementation, Two-way communication, Education and training, Emergency action guide, Contractor management, System audit, System review, Document management
IAEA safety culture model*	Policy level commitment: State of policy, management structures, resources, self regulation Managers' commitment: definition of responsibilities, definition of control of safety practices, qualifications and training, rewards and sanctions, audit, review and comparison Individuals' commitment: questioning attitude, rigorous and prudent approach, communication
Total safety culture model*	Person: knowledge, skill, ability, intelligence, motives and personality Behavior: complying, coaching, recognizing, communicating, demonstrating Environment: equipment, tools, machines, housekeeping, heat/cold, engineering, standard operating procedure
Business excellence model of	Leadership, Policy and strategy, People Management,

Safety culture model by	Safety culture dimension/Organizational Aspect
safety culture*	Resources, Processes, Customer satisfaction, People satisfaction, Impact on society, Business results
System model of safety culture*	Leadership and support, Awareness, Responsibility and control, Competence and safe behavior, Reinforcement and support from SM process

**Remark: data from (KAO, 2008)*

Olive (2006) has stated the strong safety culture characterized by several traits as the following;

- Commitment to the improvement of safety behaviors and attitudes at all organizational levels
- Organization structures and atmosphere to promotes open and clear communication
- A propensity for resilience and flexibility to adapt effectively and safely to new situations
- A prevailing attitude of constant vigilance

In order to measure or assess organization safety culture can use three different approach based on time focus, information needed and methods (Guldenmund, 2010). The first approach is academic (anothropological) to focus things from the past by collecting qualitative information based on fieldwork, ethnographical-inspired methods (observation, documentation analysis, personal interview and open discussion in groups). The second approach is analytical (psychological) to measure the present by collecting the qualitative information on the safety climate based on scales and questionnaire. Safety climate can be regarded as a snapshot of organization's safety culture and also a predictor for safety performance (EU-OSHA, 2011). According to NRCWE, it is recommended to conduct a safety culture questionnaire with support from top management, clear direction, all staffs participate and committed during the process, voluntary and transparency. The last approach is pragmatic (experience based) to measure the future by using the safety culture maturity (level) based on behaviourally anchored rating scales (BARS)

Safety Culture is a part of safety management system (SMS) which generate vary safety culture characteristics based on national culture, organization culture, industry type and leadership style (OSHA, 2011). SMS is vitally important for all industries. Without good management system and priority to safety, a safe working environment cannot be achieved in our organization. Hence without SMS in organization, it is impossible to implement systematic system to enhance safety performance in organization e.g. ISO: 14001, OHSAS 18001 and ILO-OSH 2001 to comply with country minimum regulation and for business competitive purpose.

"Safety management may be defined as the aspect of the overall management function that determines and implements the safety policy. This will involve a whole range of activities, initiatives, programs, etc., focused on technical, human and organizational aspects and referring to all the individual activities within the organization, which tend to be formalized as Safety Management System" (SMS) (Papadakis, 1997)

SMS may comprised with many elements and activities such as incident reporting system, investigation system, risk management, safety culture development, process safety and safety organization. Those elements may be law requirement in some country to ensure SMS in organization. There are tools for SMS to determine hazard and prevent the accident and process safety failure from happening for example, Swiss cheese model and Bow-tie analysis. Those tools are using to identify the barriers (e.g. organization, task, environment, equipment and people) and mitigation plan if accident happens. The consequence of the incident can lead to major accident. Implementing SMS is the most efficient way of allocating resources for safety since it not only improves working conditions, but also positively influences employees' attitude, behavior and safety culture (Fernández-Muñiz 2007). By improve SMS, it will reflect organizational structure and process which driven by safety culture to generate safety performance measured by safety indicator (Guldenmund, 2010).

Safety Culture Maturity Model

After the Chernobyl disaster in 1986, safety culture has been highlighted in high risk industry and studied by many researchers. The first stage of study, the type of safety culture has been identified into 3 stages which are pathological, calculative/bureaucratic and generative. Pathological is care less about safety and failure is covered up, bureaucratic/calculative level is the safety is just in place and organization feel comfortable on what they have even they can improve. Generative stage, safety behavior is fully integrated into employee's mind and everything they do. (Westrum & Adamski, 1999; Westrum 1991; Weick, 1987) Later on, safety culture has been extended into 5 level which reactive and proactive have been add into it. (Reason, 1997) As they aim to broaden the framework, more suitable to classification for better implementation to organization and improve the organization through increase the safety culture maturity level. In depth research of 5 levels has been defined and conducted to Oil and Gas industry in more detail set of descriptions of different type of different safety culture e.g. communication, organization attitudes and behaviors. The validation has been made with interview of senior oil and gas company executives.(Hudson, 2001; Parker, 2006). This model has been later successfully implemented to the royal dutch/shell company as "Heart and Mind program" in 2007 and is one of the best practices in oil and gas industry which aims to identify the maturity level of the organization toward the safety. Moreover, it has been highlighted into OGP report and EU-OSHA in 2010 as recommendation for safety culture improvement.

In this study, the analytical approach has been selected by developing the safety culture questionnaire to provide the surface feather of employee's perception and attitude toward safety culture. This approach is to align with company direction to measure safety culture level in order to adjust company strategic short and long-term plan to improve their safety culture and performance in organization level. Once the safety culture has been identified, gap analysis should be conducted to create a plan or roadmap in order to shift culture to proactive or generative level. The survey is designed based on International Association of Oil and Gas Producers report No. 435 (OGP, 2010), which has been used successfully by other oil and gas major to identified and evaluated particular cultural level, best practices in E&P industry e.g. hearth and minds program (Shell, 2007) and also from the academic "A framework for understanding the development of organizational safety culture" (Parker et al., 2006).

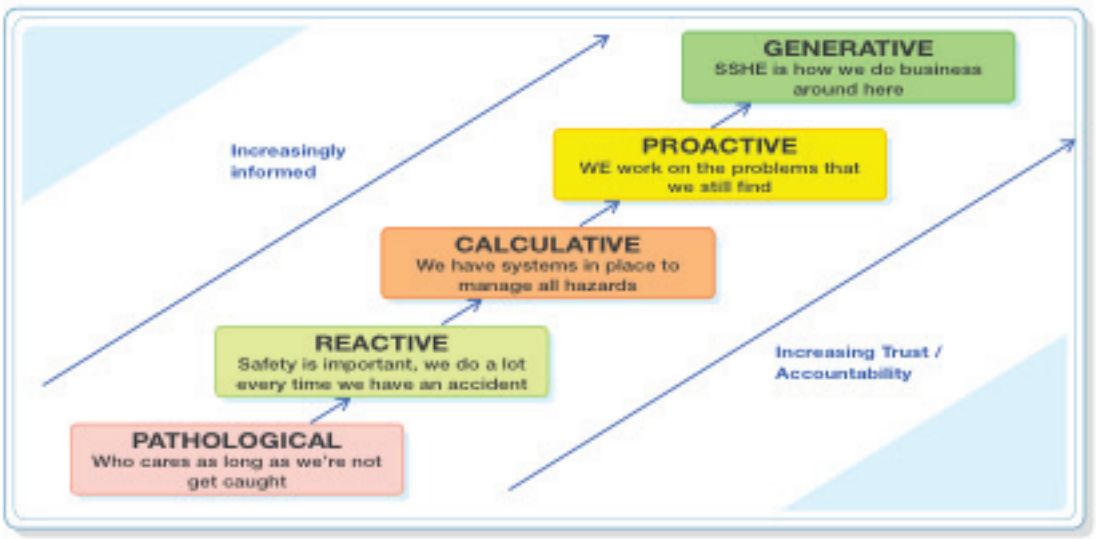


Figure.1. Safety Culture Maturity Model (Hudson, 2001)

The model used is HSE Culture ladder by "International Association of Oil and Gas Producer" (OGP), the concept has supported by Hudson (Fig.1, 2001) that define safety culture maturity model into 5 levels;

- Pathological organizations believe that individuals, typically at lower levels, cause accidents. They implement only what is mandatory, including required checks and audits. Most HSE tools are ineffective at this level, as HSE is considered an obstacle to operations. Pathological organizations respond to clear regulatory requirements, if enforced, and implement HSE programs only as needed to avoid prosecution.
- Reactive organizations consider HSE important but believe that most problems lie within the lower levels of the workforce. Organizational and individual HSE management skills are at a basic level, suggesting that HSE tools should also be simple. Tools appropriate at this level are those that address problems obvious to both management and the workforce. Tools that relate to issues that have not yet caused actual accidents are difficult to justify. Reactive organizations value those tools that bear a clear relationship to a visible issue.
- Calculative organizations believe in the value of systems in managing HSE performance and the use of a large number of tools and training. The focus on the tools is usually through analyzing metrics rather than their effectiveness i.e. number of people trained rather than an assessment of their competence. HSE professionals are seen as the drivers for the use of HSE tools and are primarily responsible for HSE performance.
- Proactive organizations consider HSE a fundamental ("core") value and leaders at all levels genuinely care for the health and well being of the staff and contractors. Such organizations understand the role of management system failures as primary causes of incidents. Information, including data related to potential consequences (near misses) as well as actual incidents, is used to identify suitable performance targets.
- Generative organizations have a high degree of self-sufficiency and strive to understand their entire operating environment. Tools that are chosen and used by the whole

organization are preferred. Mandatory tools may be counter-productive, suggesting lack of trust. Everyone feels free to highlight both real and potential issues. Workers feel empowered to resolve HSE issues, and leaders provide the support needed.

Importance of SMS and safety culture toward Sustainability development in Organization

Volunteer company received policy from Mother Company in 2011 in order to improve safety culture in organization (as one of the key success to create effective SMS). By improving the safety culture, it can benefit both direct and indirect to organization e.g. preventing major accident, increase employee morale and strengthen safety environment in operation. Moreover, Mother and volunteer company set target of moving into fortune 100 in 2012, by creating sustainable development in organization, which comprised of business, social and environment concern, aims for ISO 26000, to be listed in Down Jones Sustainability Indexes (DJSI) Company and have transparency in Global Reporting Initiative (GRI). To create sustainability and ISO 26000 in organization, company has to put importance into occupational health, safety and safety culture as they have direct impact with social progress, economic and environment e.g. labour standard, human right, revenues, shareholder return and spill prevention. For example, OHSAS 18001 and ILO-OSH: 2001 have focus on Occupational health and safety (OH&S) for manufacturer and producer perspective. They concerns much on how to improve the organization SMS and eliminate the hidden risk in operation based on the "Plan Do Check Action" (PDCA) by Deming. On the other hand, those are sub element in creating an overview of ISO: 26000 which highlighted in clause: 6.4 Labour practices, 6.4.6 Health and Safety at work and 6.4.7. Human development and training in the work place. To create a systematic ISO: 26000, SMS can be viewed as one of the prerequisite to build a solid foundation of OH&S, once it has been strengthen, expanding to consumer side is easier via social contribution as one of the ISO:26000 element.

Moreover, they have to follow each country legal and obligation requirement (clause 4.3.2) for employee who work in the company to have a safety working environment for instance, proper personal protective equipment, known hazard in working area, competency training depend on job and accident prevention. Hence, CSR can provide framework to OHS and other relevant aspect in ISO: 26000 such as clauses 6.3 Human rights, 6.4 Labour practices and 6.5 the environment. Moreover it can remind OH&S of its' importance that are usually forgotten in organization.

To be socially responsible means to think beyond just law requirement, by investing in human capital and managing relationships with the social stakeholders that are affected by consequences of the firm's decision. OH&S can being conceived as an integral, essential part of CSR. In development state of CSR, the more organization wants to improve its social reputation; OH&S can be considered as one of the instrument for CSR development. (Montero, J.M., 2009). The importance of CSR can be seen in 90% of top companies in Fortune 500 have invested in this section. (Kotler & Lee 2004) By having SMS as a prerequisite, it cannot guarantee to achieve creating sustainability development in organization because it comprise with other as well. On the other hand, effective safety culture (Proactive and Generative) can reflect effective SMS which cannot be achieved with only one or two aspect but all together. (table.3)

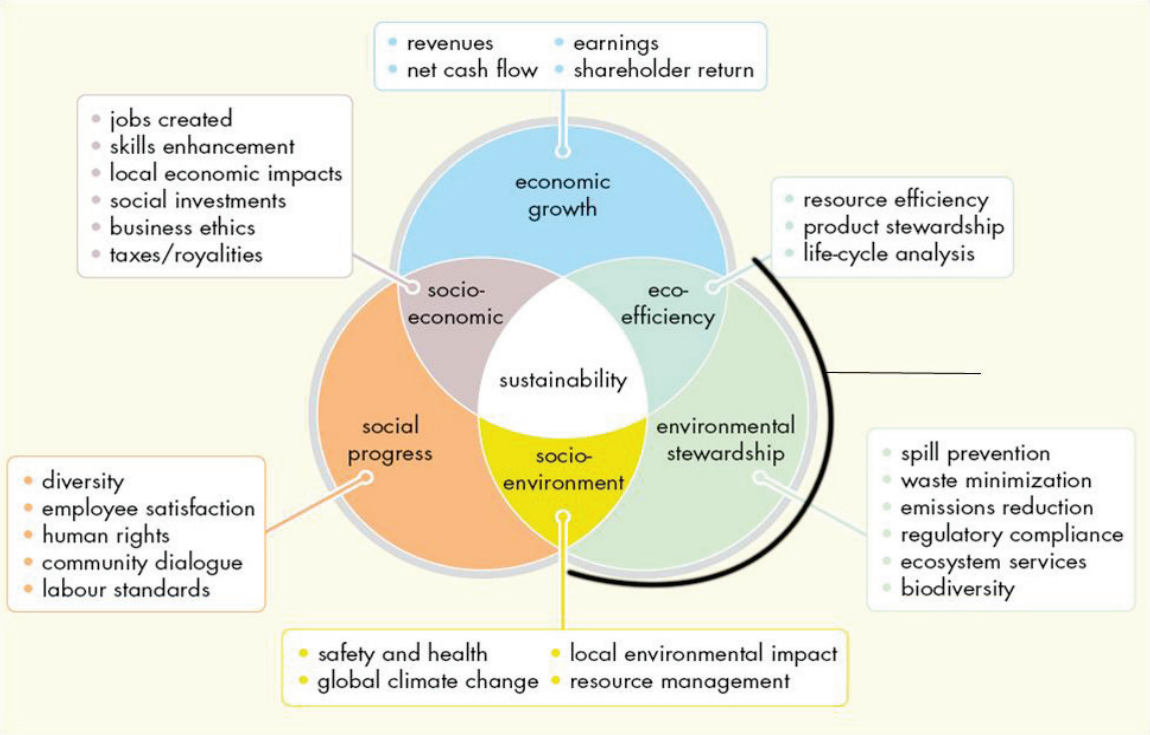


Figure.2. Volunteer company Sustainability framework (Volunteer, 2011)

This study is to confirm if "OGP Report No.435: A guide to selecting appropriate tools to improve HSE culture" are applicable and suitable for Oil and Gas industry for Upstream business in Thailand and others country subsidiary or not. Since developing safety culture in one national level may be fail to apply the same benefit in other countries (Hudson, 2007). One company, headquarter in Thailand, has volunteered for the study. The study has conducted more than 150 sessions of safety culture questionnaire in 10 locations (head office, operation site, drilling rigs, construction and exploration site) in 4 countries (Thailand, Oman, Algeria and Myanmar). Each session has 10-15 minutes of introduction on how to answer the questionnaire (likert scale, 1. pathological to 5. generative), and the explanation on each question. The result of 2,251 employee participated including safety personnel. There was 74% of target group participation across the company. The questionnaires break down into quanlitative description of each safety culture maturity state. Those based on 7 elements of company safety management system. The survey collects the age, year of experience, job position and etc. The score for each location are different depending on culture in each country and organizational culture evolution which has three stage; Founding and Early Growth, Midlife and Maturity/Decline (Schein, 2004)

Chronological SMS implementation of Volunteer Company

Regarding from table.3, trend of accident has been reduced and mitigated from 3 key areas of improvement from past to present of Technology, System and Culture (Hudson,2007). Comparing to volunteer company, it has continuous improved in safety, security, health and environment since 1994 in order to comply with international standard and industry trend.

Improvement can also categorize into 3 specific areas base on table.3 and examples are the following;

Table.5. SMS improvement of volunteer company based on Hudson model (2007)

Technology	System	Culture
1994: Establish HSE and Audit department to make sure compliance in organization	1996: Strengthen HSE internal system via compliance, audit and HSE risk assessment	1996: Developed Internal HSE Awareness survey and continuous promote
1995: Establish HSE management system, policy, committee	1996- present: provide HSE training for corporate level	2003-present: Benchmarking safety performance with OGP and peers to motivate to top quartile E&P company
1995- present: improved operation via new technology investment and hardware improvement e.g. invest new equipment and man-machine separation, close loop system and hazardous material treatment	1997-present: Implemented SSHE Management system to in line with OGP, ISO:14001, ISO 9001, ISRS and OHSAS 18001	2006 – present: Implement Behavior based safety, Felt leadership, Step change in Safety, Safety toward sustainability and life saving campaign, enhance safety leadership and commitment, safety line responsibility
1996- present: Issued corporate HSE standards, procedures, and guideline	2010: Conduct Corporate Risk profile via risk assessment	2011 - present: Introduce and implement safety culture maturity model and safety culture questionnaire with result

As high-risk industry, volunteer company cannot independently improve only one category and wait until it shows an improvement result. As the result of failure in one category implementation can significantly reflect others e.g. failure in audit and compliance in maintenance and inspection safety critical equipment can result in explosion and plant shut down. Therefore incident trend can reduce with good combination of technology, system and culture in organization. Organization safety culture can look deeper in to safety culture maturity level from pathological to generative. High level of organization safety culture require certain level of technology and system e.g. audit with peers assist and benchmarking performance with international organization (OGP, 2011)

FRAMEWORK

OGP report No.435 gives us the HSE culture ladder, which generate into 5 levels e.g. pathological, reactive, calculative, proactive and generative. The report provides the description and tool guide to improve HSE culture in each HSE culture. To identify the organization HSE safety culture or safety culture maturity level, safety culture questionnaire is needed. The survey developed from OGP report, Heart and Mind program, and academic research (Parker et al.,

2006, Hudson, 2001). The 7 dimensions have been chosen to match organization SMS, referred to ISO:18001 and easy to recognize by employee. The description for each dimension (attribute in survey) describe as the following;

- Leadership and Commitment: Top-down commitment and Safety, security, health and environment (SSHE) culture essential to the success of the SSHE management system
- Policy and Strategic Objective: Corporate intentions, principles of action and aspirations with respect to SSHE
- Organization, Resources and Documentation: Organization of people, resources and documentation for sound SSHE performance
- Evaluation and Risk Management: Identification and evaluation of SSHE risks, for activities, products and services and development of risk reduction measures
- Planning and Operational Control: Planning the conduct of work activities, including planning for changes and emergency response
- Implementation and Monitoring: Performance and monitoring of activities, and how corrective action is to be taken when necessary
- Audit and review: Periodic assessments of SSHE management system performance effectiveness and fundamental suitability

In each dimension there are sub element standard to support every hierarchy level e.g., Corporate oversight, roles and responsibility, due diligence, contractor management, risk management, training and competency, permit to work, operational safety and asset integrity management. The framework is based on OGP report, literature review(Parker et al., 2006) and "Heart and Mind" program from Shell and with volunteer company – HSE division validation.

METHOD

International Association of Oil and Gas Producers (OGP) report No:435

The report provides tools which can be used to improve HSE performance in each safety culture maturity level from pathological to generative. 15 HSE tools from OGP report e.g. reporting/recording HSE information, incident investigation, HSE management system (ISO: 9000, ISO: 14000 and OHASA: 18000), questionnaire and survey, were selected to match with company SMS as the starting point for develop safety culture questionnaire.

Table.6. Example of HSE tools in each safety culture maturity level (OGP, 2011)

	Tool type	Description	Pathological	Reactive	Calculative	Proactive	Generative
1	Reporting and recording HSE information (incidents & near misses)	Mandatory reporting	→	→	→	→	→
		Anonymous reporting		→	→	→	
		Confidential reporting			→	→	
		Open (non-confidential) reporting			→	→	→
2	Incident investigation and analysis	Incident investigation (mandatory)	→	→	→	→	→
		Root cause analysis			→	→	→
		Proactive analysis				→	→
3	Auditing	Professional audits	→	→	→		
		Benchmarking			→	→	→
		Management system audits			→	→	
		Management site visits		→	→	→	→
		Peer assists				→	→

Selecting certain tools is likely to be ineffective and given negative feedback to wrong HSE culture. For example, Manager and supervisor HSE training maybe ineffective in low safety culture level comparing prioritize training to workforce level, anonymous reporting HSE information may require for reactive and calculative level rather than open reporting which suitable for proactive and generative organization. The higher of safety culture level in organization, the better and easier of safety improvement it can be as employee and supervisor are positive for improvement. While low level of safety culture level see the same situation as negative auditing their performance and checking their operation.

Management acceptance

Volunteer company bought Royal Dutch/Shell Group's entire Thailand upstream petroleum assets in 2003. After merged with Shell, company continuously adapts and improves their SMS along with their personnel as the result of current SMS has tailor from both companies. When firstly introduced the safety culture maturity level to HSE personnel, there were no resistance toward the concept and theory as the company SMS of 7 dimensions (elements) are much alike with Hearts and Mind program with long history of Shell implementation and more than 10 years of academic research. Top management understands and supports the concept of improve organization safety culture level by knowing where they stand in safety culture ladder first and create the roadmap toward improvement

.

Questionnaire

Questionnaire has been implemented from OGP report No.435, Shell best practice in E&P business of Heart and Mind program and academic researches. 20 questions have been selected

and developed with each information dimension, 1-5 ranking scale from pathological to generative. The survey package not come only the questionnaires but also combines with many items e.g. understanding and developing safety culture in organization to show its importance toward safety and corporate strategic objective, CEO message to show top management support, correlation between safety performance and behavior base safety, objective of safety culture questionnaire and its life cycle how to improve after getting the result.

Pilot test

Pilot test has been conducted and validated with HSE division before the campaign launch. The questionnaire, 20 questions, has been presented in Corporate HSE division monthly meeting and asked to fill up and comment the survey. Members are from many disciplines for instance; Occupational health and safety, Safety engineer, technical safety, environment engineer, operational safety, safety advisor and analyst with experience range between 1 – 35 years in safety field. Few adjustment and comment have been identified to the survey in order to comply with organization. Overall feedbacks from HSE division are positive and results are practical in volunteer E&P organization to find the state of safety culture maturity level. The reliability testing for questionnaire with 20 items had conducted by using cronbanc's alpha and the result shown in Appendix A, Table 11. Attribute 1, 4, 6 and 7 had acceptable reliability coefficients. While attribute 2 and 3 shown the coefficients is below 0.6 but could not be improved by removing any of the items.

Respondents

The safety culture questionnaire has been supported and kicked off from Management Committee level to encourage employee to participate in this survey. The roadmap has been made, follow and continuous promote 1-2 months before the survey conducted in all 10 location for both onshore and offshore operating asset, construction site, drilling rig, exploration and seismic in both domestic and international country. 150 plus session were conducted with 2,251 employee participated as 74% of target group participation across the organization.

RESULTS

Organization safety culture maturity level

The average corporate score of the questionnaire is 3.33 or calculative level that describe in 7 attributes of company safety management system and 20 questions. Volunteer company has improved their safety performance continuously as result shown in lost time injury frequency (LTIF) and total recordable injury rate (TRIR) which better result benchmarking with OGP and other peers. The changing perspective of top management toward to HSE is there was major accident in gulf of Australia, 2008 that caused significantly impact on financial, reputation, and production to company. As organization see the current status of safety culture maturity, in each element and attribute require different methods, actions and time for improvement. The result shown that the 3 lowest score are safety talk, who check SSHE in daily basis and benchmarking with 11%, 10% and 6%. This reflect the organization culture which before the questionnaire

conducted, each location concern about safety that related to their task and tools for knowledge sharing and centralization e.g. tools box talk, hazard reporting campaign, corporate statistics were in place but been put aside and insignificant. In additional, safety talk requires leadership and support from top management to be role model for subordinate to follow; communication and who in charge have to be clear and visible.

Bad example of management in production informal comment toward safety

> "When accident happens, it is not a job for front line but corporate safety to investigate and create a countermeasure, conduct a gap analysis and report for us. We have other task to complete not this."

This shown bad and traditional conflict between safety and production issues as production team has no safety concern and poor knowledge. In multi-national organization, if lines of responsibilities have no safety ownership in their work, it is very hard to maintain safe environment in their operation and priority in safety is insignificant. Safety culture maturity level cannot be improved without solving this problem. Head of safety division of volunteered company stated that for this problem management perspective can be changed by reflecting their safety performance indicator e.g. lagging and leading indicator in corporate level to their KPIs, why still accident happen when all SMS are all in place?, Safety leadership and importance from line of responsibility is needed (HSE Division, 2011).

Result comparison: Safety culture questionnaire vs OGP: HSE tools

From figure1 and table.3 shown the importance of safety culture, which categorized into 5 levels and company cannot improve safety culture independently without good technology and management system in place. To identify safety culture maturity level in organization, safety culture questionnaire is necessary to measure organization safety culture level. Then to move up safety culture level in organization, understanding on each tools to improve culture along with proper SMS and technology are fundamental. Good safety culture in organization can assist implementing sustainability and ISO 26000 easier as it related in figure2 for instance company revenue and stakeholder return increase due to cost reduction in facility report due to explosion accident and recuperation cost to employee decrease. Moreover, OGP provide 15 HSE tools, which effective and accepted for each safety culture maturity level for instance HSE risk management and situation awareness. To validate volunteer company safety culture questionnaire result with OGP tools is necessary to confirm whether company uses the appropriate tools with their safety culture level or not.

From table.5 provide with matching OGP HSE tools with safety culture questionnaire attributes, average safety culture maturity result, volunteer company current tools and comparison result. The results from safety culture questionnaire are applicable to OGP report and can measure safety maturity level of volunteer company in Thailand. Moreover, it shown that volunteer company develops SMS and tools match with their safety culture level.

Safety culture maturity stage of each location

Volunteer company is a large multi-national organization in many countries. The safety culture maturity for corporate level and each operating location has been measured by safety culture questionnaire. Each location's job scope is different and safety management system and culture has developed by management level, safety manager with corporate HSE division assistance. There are old and new locations that have different of safety history and services year from 2-30 years. Those have been tested by pearson correlation to find the relation between safety culture maturity level and location service year and found the result is not correlate ($n= 10$, $r= 0.19$, sig 2 tail = 0.58, $p>0.05$). Long length of service with poor safety culture maturity level can reflect in poor management leadership, misdirection of safety culture, insignificant of safety performance, bad safety attitude of supervisor and employee level.

DISCUSSION

Different from other safety culture questionnaire

The survey has been launched with HSE division annual campaign, to identify corporate safety culture maturity level, and strong commitment from CEO. Moreover, it is not just send the survey with description and waiting for respondent rate, it has been explain by engineer e.g. what is the survey for, each element description and way forward, in small group sessions (approx 30 persons) with 150 sessions in 10 different locations. Top management are very positive for this survey and greatly support for this activities for instance top management are the first group completed the survey, employee can use their non-busy working time to attend the survey session, pilot testing with HSE division, can be use as employee safety KPI and promoting the campaign, it is sure not get good participation and result in the survey without their support. This method of surveying all employees are different from Hudson & Willeke (2000) conservative method that only focuses evaluation by manager than operators and supervisor as they better calibrate the result. The conservative method can give us the overview result of safety culture but to drive and create culture shift, result from everyone in organization are needed.

Uncertainty

The survey result found that in some location or division, especially employee in front line level, may bias to this survey as the result was off the group. The discussion has been made with that location management level to verify the data whether there are actually work related issues or not. Result found that there are some sensitive matters with welfares, personal negative attitude toward safety officer. 1% of sample size has been excluded from result analysis due to uncertainty of the answers given.

Analysis

From the result shown the company position of safety culture maturity is in calculative level. Each element categorized into each job position and location shown in percentage. Those can give feedback on how corporate will to tackle this problem to improve employee's mindset to

higher level. HSE division needs to create a visible leadership and support to all employee level in order to show that they are not relying on each location safety management system but also from corporate level. From survey result shown the area they should focus on e.g., procedures corporate oversight in organization level, improve SMS in specific location, create more standard and procedures in each specific job.

Not only the result shown where organization stand in the safety culture maturity level, HSE division can also use results of the survey to adjust their long term plan and roadmap in order to create an effective culture shift in organization. Certain techniques use effectively in one safety culture maturity organization is not guarantee to be successful in other lower culture level as they have not reached certain level of maturity (Flemming, 2001; OGP report, 2011). As company knows where they stand in safety culture ladder, they have to be more focus on contractor management for those safety culture maturity levels lower than the company itself. As contractor cannot meet maintain the safety standard and level as company itself which need more supervision working in company area.

First stage: Volunteer company capability develop from Pathological – Calculative

In founding and early growth stage, volunteer company established in 1992 as National Exploration and Production Company. From safety culture questionnaire reveal the stage of maturity level of volunteer company at level 3 Calculative. We can assume that in total of 19 years since the company has founded, safety culture has been continuously improved and can trace back their performance shown by safety statistics. Each stage of maturity level has different on how employee act and respond to each tool e.g. the quality of incident report and investigation result are based on the maturity level; just to complete the report in low level and more detail and conduct root cause analysis in higher level. In safety culture maturity model; each step is comprise of safety attributes categorized into 3 key areas as indicated in Table.3 and we can confirm the development of safety maturity level of volunteer company from chronological improvement for 3 keys area with EU-OSHA and OGP validation. The higher safety culture maturity in the organization, the more complexity and relationship between each attribute are. From pathological to reactive (capability improvement), safety are in place but not well constructive as organization tends to be in Founding and Early stage of life cycle and importance of SMS is insignificant comparing to production and quality. Moreover, blame culture and hidden report when incident happen are likely to be seen on this stage due to production and profitability are more important than safety and culture themselves. By implementing standardization and essential technology in each industry help establishing SMS into the system in early stage e.g. ISO 18001, TIS 18001 and ILO-OSH: 2001. On the other hand, calculative to generative (maturity improvement) require good combination of technology, system, positive culture and time for organization to recognize the importance of safety together with management. On this stage, even organization invests more into technology and system, culture is not likely to significantly improve as the first 2 stages due to improvement should focus on people interact with technology and system. By lacking one another of key areas, safety culture cannot move to another step. The better safety culture maturity level in organization, the better employees are willing to change to improve safety in operating site and cares for their colleagues.

Volunteer company roadmap to create culture shift from Calculative to Generative

From safety culture questionnaire/climate survey in 2011, the result shown volunteer company is in Calculative level (level.3). To create a culture shift from calculative into proactive and even generative, volunteer company creates 3 years plan roadmap to enhance the safety culture in prior to next survey. It can summarize into 5 actions as the following;

1. **Safety moment in all meeting**

The result from safety culture questionnaire shown the safety talk is the lowest score among all questionnaire. This reflect poor safety awareness in the organization with mean = 2.93 and standard deviation = 1.11. To change organizational behavior toward safety talk, safety team has to create a safety talk database for everyone usage. Corporate safety encourage before every meeting start, it should begin with safety talk or sharing to all member. It can be information sharing either work or non-work related to build up safety awareness in corporate and operation level. Safety team has taken serious action of being representative of safety talk in early stage of the campaign using Top-down approach in every management committee which led by CEO, conducted twice a month or more. Once management understands and use to the safety talk, implementation in lower level is easier with their support. From this change of employee and management in safety talk in broad organization, it took at least a year to see the improvement for volunteer company. Moreover, safety talk has been indicated as one of the element in annual safety key performance indicator for leading indicator of all management in organization to ensure its effectiveness in top-down approach.

2. **Safe and Happy workplace**

This action aims to create common understanding of "safety is everybody's responsibility" via different communication route internally e.g. visualize safety policy and campaign and technical information board in various location in headquarter and operating asset. It also encourage employee to report on "good" and "to be improved" regarding behavior, equipment and process by using "Safety observation card", "Hazard reporting card" and transparency in incident reporting. The succession of this action depends on how employees see the campaign as encouragement to improve not finding and line of management see this action as positive action not negative. Hidden reports, ignorance to improve and change are likely to happen if employee and line of management have negative feeling and blame culture in organization. Moreover, in this action, corporate safety should develop a campaign to improve safety in organization for incident statistics, increase employee awareness and create a common understanding and also roll out the campaign in corporate level and in each operating location.

3. **Safety Cares and Safety Share**

Information and Knowledge management has been highlighted in this action. Internal communication has been improved with intranet to be center of information sharing for safety policy, standard, procedure and guideline with highlight activities. In addition, safety has become part key activities in organization e.g. operational excellence, sustainable development, corporate

communication, risk management, project and technical review. This is to put safety into every related campaign as to make it visible to employee and put into the beginning of design phase in every project to make sure it comply with safety requirement. The result of safety culture questionnaire shown employee in the head office has the lowest score among all location. This is a stereotype of office work e.g. human resources, financial, and planning division. Those always have safety awareness lower than operating level due to the nature of working environment are different. To create a culture shift in organization, this area needs to be improved by using safety line partner concept to strengthen safety information sharing and communication between each division in company. The concept is to have a safety representative for each division to summary each month safety performance, way forward, area of improvement and receive feedback as two-way communication to improve safety performance and raise safety awareness in corporate level. Moreover, in high risk division e.g. construction, drilling, and production; corporate safety will provide them with safety advisor to make sure all risky activities are comply with safety requirement.

4. Safety is a license to operate

Volunteer company is in high-risk industry, they do not tolerate any mistakes because it signifies the future and prosperity of the organization. This is to ensure best practice to comply with corporate safety management standard for instance safety due diligence, competency assessment and safety technical audit. Company's growth has continuously increase not only in domestic but also international since 1992. Employee and contractor tend to exposure with risk in climate change; rush work, tight schedule and unfamiliar atmosphere. To comply with SMS, implement of safety document e.g. standards, procedures and guideline must cover all operation for employee to understand the nature and caution of each work beforehand and following the given instruction. Those aim to minimize the risk as low as possibly e.g. commissioning, decommissioning, drilling and seismic. In low safety culture maturity level, the importance of standards, procedures and guidelines are shown only when incident or unexpected event is occur in the system and clarification is needed. On the other hand, in higher level, employee tends to comply with them and always conduct risk assessment when there are changes in the system. When all documents are in place, safety corporate has to roll out to everyone in the organization in order to have common understanding and create a compliance culture. To confirm whether operating level use standard, procedure, guideline or not, safety expert and line of management have to conduct audit and review periodically. Moreover, corporate safety has introduced leading indicators to all employees as one of the annual safety KPIs as to preventing unexpected event from happening as lagging indicator, e.g. LTIF, TRIR and LOPCR, provide area of improvement in each operating location.

5. Safety mindset

In this action aims to improve the safety culture in organization and understand the safety target and goal of incident-free organization in the future. To have everyone understand the same safety languages, training course provided by corporate safety is required to all employee in organization. The course is to show importance of safety culture, raise employee safety awareness, and understand the existing tools, safety as prerequisite by the government for each

country and SMS in organization. Company benchmarks safety performance with peer in domestic & international level and comparing to "International Association of Oil and Gas producers" (OGP). Therefore, it is to motivate both employee and management to drive company to achieve top quartile performance in global level. Moreover, corporate safety statistics has been updated to CEO and top management in every management committee meeting to raise awareness and caution in safety situation. If accidents are trending upward, CEO, corporate safety and line of management will send the alert notification to all stakeholders to be aware of the situation and line partner will close monitoring the operation level to prevent incident for reoccurrence.

CONLUSION

The safety culture maturity has been identified and organization learns its own position for developing future implementation plan. The result from safety culture questionnaire and implementation of "OGP Report No.435: A guide to selecting appropriate tools to improve HSE culture", best practice from E&P industry and academic research are practical in Volunteered Thailand E&P company and their subsidiary with good positive feedback from top management and HSE personnel. Research team and HSE division agree that top management leadership is very important and to make it visible to front line level require an effective communication e.g. SMS and behavior base safety mini-road show from corporate, safety commitment from line of responsibility, tools box talk and importance of good safety statistics result. When safety is a common thing in everyday operation, employees are easier to say what is wrong their normal routine and willingly to keep safe working environment and behavior. Moreover, line responsibility is important as safety is not only a task for corporate HSE to maintain the good safety performance but line management should take ownership all in their task. Those are included into volunteer company roadmap to create a culture shift to another level which all actions have been tailor made according the gap shown in safety culture questionnaire result. 5 actions in volunteer company roadmap may different in other organization and country due to focus area and culture are different. Roadmap aims to increase safety awareness for employee in different methods and many communication channels under the concept of development technology, system and culture together. Hence, to improve a culture with the same technology and system will take a long journey to complete. There are no prerequisites for each action; it can be implemented at the same time with other action as proper. We can monitor the result of the implementation by looking at the lagging indicator for instance incident rate after kick off the campaign. If the root cause/underlying cause are still human factor/error, it mean we have to trace back on what component we are missing. e.g. "does enforcement in some safety issues are necessary for change?", "do we need more top management leadership and commitment?" and "why injure person act like that and the motive behind his act?". By monitoring not only the incident but other area in action plan e.g. participation in safety campaign and compliance to safety standard can act like a small adjustment in order to create an high level of safety culture level in organization. In 2012, the roadmap helps volunteer company to improve their safety performance to be the best in their history of LTIF, TRIR and incident severity has been reduced. There are limitations for this study; the study has conducted to only one volunteered upstream business in Thailand. More company needs to test if framework will practical in other E&P company and broaden into other industry in Thailand or need to revise in any element.

REFERENCES

1. Board of Investment (BOI, 2012), “The report Thailand 2012” , Bangkok, Thailand, from http://www.boi.go.th
2. British Petroleum (BP, 2011), “Statistical review of World energy 2011”, from http://www.bp.com/sectionbodycopy.do?categoryId=7500&contentId=7068481
3. Changing Mind (2000). “A practical guide for behavioural change in the oil and gas industry”, from http://www.stepchangeinsafety.net/knowledgecentre/publications/publication.cfm/publicationid/16
4. Department of Mineral Fuels (2011). Annual report, Ministry of Energy, Bangkok, Thailand, from http://www.dmf.go.th
5. EU-OSHA (2011). "Occupational Safety and Health culture assessment – A review of main approaches and select tools." European Agency for Safety and Health at Work. from http://europa.eu.
6. Fernández-Muñiz, B., J. M. Montes-Peón, et al. (2007). "Safety management system: Development and validation of a multidimensional scale." Journal of Loss Prevention in the Process Industries 20(1): 52-68.
7. Filho, A. P. G., J. C. S. Andrade, et al. (2010). "A safety culture maturity model for petrochemical companies in Brazil." Safety Science 48(5): 615-624.
8. Flin, R., Mearns, KJ., &Whitaker, SM. (2001). 'Benchmarking safety climate in hazardous environments: A longitudinal, inter-organizational approach'. *Risk Analysis*, vol 21, no. 4, pp. 771-786
9. Fleming, M. (2001). Safety culture maturity model. Other Information: Price 10 UK pounds; PBD: 2001. United Kingdom: 9 pages.
10. Flin, R., K. Mearns, et al. (2000). "Measuring safety climate: identifying the common features." Safety Science 34(1–3): 177-192.
11. Guldenmund, F. W. (2000). "The nature of safety culture: a review of theory and research." Safety Science 34(1–3): 215-257.
12. Guldenmund, F. W. (2010). "(Mis)understanding Safety Culture and Its Relationship to Safety Management." Risk Analysis 30(10): 1466-1480.
13. Hudson, P., Willekes, F.C., 2000. The hearts and minds project in an operating company: developing tools to measure cultural factors. In: Proceeding of the SPE International Conference on Health, Safety, and the Environment in Oil and Gas Exploration and Production Stavanger, Norway. Richardson, Texas (SPE 61228).
14. Hudson, P. (2007). "Implementing a safety culture in a major multi-national." Safety Science 45(6): 697-722.
15. ILO (2001). Guidelines on Occupational Safety and Health Management System. Geneva, International Labour Office.
16. INSAG (1991), Safety Culture, Safety Report Series No. 75-INSAG-4, IAEA, International Atomic Energy Agency, Vienna, 1991.
17. International Organization for Standardization, 2011. The ISO Survey. Available at ISO Central secretariat http://www.iso.org/iso/survey2009.pdf
18. Kao, C.-S., W. H. Lai, et al. (2008). "Safety culture factors, group differences, and risk perception in five petrochemical plants." Process Safety Progress 27(2): 145-152.

19. Kotler, P., Lee, N., 2004. Corporate Social Responsibility: Doing the Most Good for Your Company and Your Cause. John Wiley & Sons, New York, NY.
20. Lawrie, M., D. Parker, et al. (2006). "Investigating employee perceptions of a framework of safety culture maturity." Safety Science 44(3): 259-276.
21. Ministry of Labour (2012), "2011 Annual Report", Bangkok, Thailand.
22. Montero, J.M., Araque, R.A., Rey, J.M., 2009. Occupational health and safety in the framework of corporate social responsibility, Safety Science 47, 1440 -1445
23. Occupational Health and Safety Management systems (2007) - Guidelines for the implementation of OHSAS 18001:2007. Occupational Health and Safety Assessment Series. London, British Standards Institution.
24. OGP (2010). A guide to selecting appropriate tools to improve HSE Culture, report no.435, International Association of Oil & Gas Producer, from http://www.ogp.org.uk/
25. OGP (2011). Safety performance indicator -2011 data, International Association of Oil and & Gas producer, from http://www.ogp.org.uk/
26. Olive, C., T. M. O'Connor, et al. (2006). "Relationship of safety culture and process safety." Journal of Hazardous Materials 130(1–2): 133-140.
27. Papadakis, G.A., A. Amendola (1997), Guidance on the Preparation of a Safety Report to Meet the Requirements of Council Directive 96/82/EC (Seveso II), Joint Research Centre, European Commission, Luxembourg.
28. Parker, D., M. Lawrie, et al. (2006). "A framework for understanding the development of organisational safety culture." Safety Science 44(6): 551-562.
29. Qabazard, A. and B. S. Srikanth (2011). Result of Sustainable Safety Performance by Building Safety Culture in a Multi-Cultural Workforce. International Petroleum Technology Conference, Bangkok Convention Center, Bangkok, Thailand.
30. Reason, J. (1997), Managing the risks of Organisational Accidents. Ashgate, Aldershot
31. Schein, E. H. (2004). Organizational Culture and Leadership. San Francisco, Jossey-Bass.
32. Thailand Industrial Standard (TIS, 1999), Ministry of Industrial, Bangkok, Thailand
33. TMAP-EM (2011), Jirisuka model, Toyota Motor Asia Pacific- Engineering & Manufacturing, Bangkok, Thailand
34. Westrum, R. (1991) Cultures with Requisite Imagination. In J.Wise, P.Stager & J.Hopkin (Eds.) Verification and Validation in Complex Man-Machine Systems. Springer, New York
35. Westrum, R. & Adamski, A.J. (1999) Organizational Factors Associated with Safety and Mission Success in Aviation Environments. In D.J..Garland, J.A. Wise & V.D.Hopkin (Eds) Handbook of Aviation HumanFactors. Lawrence Erlbaum, Mahwah, NJ.
36. Weick, K.E., 1987. Organizational culture as a source of high reliability. California Management Review 29 (2), 112-127.
37. Wu, T.-C., S.-H. Chang, et al. (2011). "Safety leadership and safety performance in petrochemical industries: The mediating role of safety climate." Journal of Loss Prevention in the Process Industries 24(6): 716-721.
38. Wu, T.-C., C.-H. Chen, et al. (2008). "A correlation among safety leadership, safety climate and safety performance." Journal of Loss Prevention in the Process Industries 21(3): 307-318.

Appendix A

OGP HSE tools	Match with Volunteer company safety culture questionnaire/SMS	Average safety culture questionnaire result	Volunteer company current tools based on OGP report	Comparing tools type with OGP safety culture level (lower/ok/better)*
1. Reporting and recording HSE information	Attribute 6	3.37	-Open (non-confidential) reporting	Ok
2. Incident investigation and analysis	Attribute 6	3.37	-Incident investigation -Root cause and proactive analysis	Ok
3. Auditing	Attribute 7	3.26	- Benchmarking - Management system audits - Management site visit	Ok
4. Human factors in design	Attribute 5	3.58	- HF design standard – voluntary - Operator design review	Ok
5. Work practices and procedures	Attribute 5	3.58	- Mandatory standards - Decision- based practices	Ok
6. HSE risk management	Attribute 4	3.4	- JSA - PTRA - MOC	Ok
7. HSE management systems	Overall SMS	3.33**	- ISO, OHSAS, TIS	Ok
8. HSE training and competence	Attribute 3	3.2	- Workforce, supervisory, Manager and Executive HSE training	Better
9. HSE appraisals	Attribute 7	3.26	- Performance appraisals - 360 degree appraisals - HSE leadership assessment	Ok

OGP HSE tools	Match with Volunteer company safety culture questionnaire/SMS	Average safety culture questionnaire result	Volunteer company current tools based on OGP report	Comparing tools type with OGP safety culture level (lower/ok/better)*
10. Situation awareness	Attribute 2	3.3	- Supervisor led task discussion - Self-led task evaluation	Ok
11. Questionnaire and surveys	Attribute 6	3.37	- Safety culture questionnaire	Ok
12. Observation and intervention	Attribute 6	3.37	- Observation by supervisor - Reinforcement of positive actions	Ok
13. Incentive schemes	Attribute 1	3.32	- Performance and behaviour recognition	Ok
14. HSE communication	Attribute 1	3.32	- Toolbox talks - HSE meeting - HSE alerts - HSE newsletters - Handover information	Ok
15 Other HSE tools	Overall SMS	3.33**	- Step change in SSHE - Life saving program	Ok

**Remark 1. For Tools type with OGP safety culture level – lower mean using the safety tools lower than measured*
***Remark 2. For HSE tools number 7 and 15 compare with average of overall safety culture questionnaire result*

Table 7: HSE tools comparison with Safety culture maturity result of volunteer company

Table.8. Result of safety culture questionnaire by attribute

Attribute	Mean	Standard Deviation
Attribute 1: Leadership & Commitment	3.32	0.90
1.1 Communicating SSHE issues with the workforce	3.31	0.84
1.2 Commitment level of workforce	3.45	0.92
1.3 Reward for good SSHE performance	3.24	0.93
Attribute 2: Policy & Strategic Objective	3.3	1.02
2.1 Who causes accident in mgmt viewpoint	3.43	1.01
2.2 Balance between SSHE/profit	3.55	0.88
2.3 Safety talk	2.93	1.11
Attribute 3: Organization Resources & Documentation	3.2	0.93
3.1 Contractor Management	3.16	0.91
3.2 Competency/training	3.16	0.97
3.3 Size/Status of SSHE group	3.42	0.75
Attribute 4: Evaluation & Risk Management	3.4	0.86
4.1 Work planning and other	3.45	0.84
4.2 Work-site job SSHE techniques	3.37	0.87
Attribute 5: Implementation & Operational Control	3.58	0.93
5.1 Purpose of SSHE procedures	3.58	0.93
Attribute 6: Monitoring & Measurement	3.37	0.93
6.1 Incident/accident reporting investigation and analysis	3.34	0.93
6.2 Hazard reporting/ Safety observation & communication	3.3	0.86
6.3 What happen after accident feedback lopp being closed?	3.66	1.02
6.4 Who checks SSHE daily basis?	3.18	0.97
6.5 SSHE management perspective	3.41	0.84
6.6 Bahavioural Based Safety	3.36	0.91
Attribute 7: Audit & Review	3.26	0.96
7.1 SSHE Audit & Review	3.27	0.90
7.2 Benchmarking, trends and statistics in SSHE	3.25	1.01

Table.9. Result of each location with location life cycle

	location 1	location 2	location 3	location 4	location 5	location 6	location 7	location 8	location 9	location 10
Score	3.6	3.53	3.29	3.21	3.48	3.62	3.21	3.33	4.37	3.33
Life cycle (year)	19	3	4	27	30	6	9	6	19	2

Table.10. Result of each job position by attribute

	Leadership & Commitment		Policy & Strategic		Organization		Evaluation & Risk Mgmt		Implementation & Operation		Monitoring & Measurement		Audit & Review	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Middle Manager	3.41	0.84	3.44	0.92	3.27	0.75	3.53	0.81	3.70	0.85	3.50	0.94	3.43	0.92
Vice President	3.47	0.87	3.53	0.86	3.52	0.60	0.00	0.00	3.87	0.82	3.56	0.82	3.38	0.78
SSHE Advisory	3.41	0.89	3.36	0.94	3.32	0.85	3.52	0.83	3.55	0.83	3.49	0.84	3.40	0.84
Front Line Supervisor	3.33	0.91	3.29	0.97	3.13	0.89	3.48	0.75	3.61	0.88	3.42	0.87	3.08	0.98
Workforce	3.32	0.92	3.29	1.01	3.17	0.94	3.39	0.92	3.56	0.91	3.36	0.99	0.00	0.00

Table.11. Result of each attribute with Cronbach's Alpha (Likert scale)

Attribute	Mean	Standard Deviation	Cronbach's Alpha	#Item
Attribute 1: Leadership & Commitment	3.32	0.90	0.676	3
Attribute 2: Policy & Strategic Objective	3.3	1.02	0.517	3
Attribute 3: Organization Resources & Documentation	3.2	0.93	0.585	3
Attribute 4: Evaluation & Risk Management	3.4	0.86	0.777	2
Attribute 5: Implementation & Operational Control	3.58	0.93	N/A	1
Attribute 6: Monitoring & Measurement	3.37	0.93	0.791	6
Attribute 7: Audit & Review	3.26	0.96	0.613	2

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

INVESTIGATING THE PERCEIVED OF E-LEADERSHIP STYLE CHANGE AND ITS CONSEQUENCE IN VIRTUAL CONTEXT

Kai-Tang Fan, Lunghwa University of Science and Technology
Email: ktfan021@gmail.com

ABSTRACT

The main purpose of this study was to test the prescriptions for virtual leadership and leadership style change, based on the situational leadership theory. This study first manipulated virtual leadership by using email in accordance with transformational and transactional leadership theory. Then, this study investigated the possibility of changing leadership style and examined its effects on leadership effectiveness.

This research employed a 2x2x2 factorial experiment design to investigate the impacts of virtual leadership style (transformational vs. transactional), leadership style change (transformational to transactional/ transactional to transformational/ pure transformational/ pure transactional), and control mechanism (process-oriented vs. outcome-oriented) on leadership effectiveness. 130 undergraduate students served as virtual team members that were required to use a Web-based group decision support system to support their teamwork.

The results indicated that perception of transformational or transactional leadership style and leadership change was significantly stronger in accord with the assigned situation. Further evidence revealed that the interaction effect of leadership style change and control mechanism on leadership effectiveness were also significant. Corresponding to the situational leadership theory, the leadership matched with control mechanism led to higher leadership effectiveness relative to the mismatched condition. This research yield important inferences regarding the situational leadership in virtual context. The suggestions and contributions of this study as well as the managerial implications are also presented.

Keywords：Virtual leadership, Leadership style change, Situational leadership theory

INTRODUCTION

Virtual collaboration is a relatively new trend in knowledge-based society. It offers a wide range of potential benefits to organizations (Townsend, DeMarie, & Hendrickson, 1998; Powell et al., 2004). The increasing popularity of research has focus on examining many aspects in virtual context (Powell, Piccoli, & Ives, 2004). For instance, Microsoft often uses virtual teams to support major global corporate customer sales and post sales services (Jarvenpaa, Leidner, & Pearlson, 1995). How do people cooperate in virtual context? People who works in virtual context are most typically consisting of groups of geographically and/or temporally dispersed members who accomplish their work primarily via information and telecommunication

technologies (Ocker, 2005; DeSanctis & Poole, 1997; Jarvenpaa & Leidner, 1999; Lipnack & Stamps, 1997; Powell et al., 2004), such as computer-mediated communication (CMCS) and group decision support systems (GDSS) that may help facilitate the group problem solving processes and improve the decision quality.

Past research have identified that leadership is vital for team effectiveness in virtual context (Kayworth & Leidner, 2001/2002). Some theorists believed that leadership can be classified into transformational and transactional leadership (Burns, 1978), and the transformational leadership is vital for many behavioral outcomes (e.g., Avolio, Waldman, & Einstein, 1988; Avolio, Bass, & Jung, 1999; Bass, 1985; Yammarino & Bass, 1990; Bass, 1998; Shin & Zhou, 2003). For example, Sosik, Kahai, and Avolio (1998) conducted a laboratory study with one hundred fifty-nine undergraduate students to examine the effects of transformational leadership on creativity. The results showed that higher level of transformational leadership showed more creative performance, such as idea elaboration, flexibility in idea generation, and proposals of original solutions.

Traditionally, organizations or teams mostly rely on face-to-face (FtF) meetings in problem solving process (Ocker, 2005). Leaders can communicate with subordinates through multiple modes of face-to-face conversation, such as paraverbal (tone of voice, inflection, voice volume) and nonverbal (eye movement, facial expression, hand gestures, and other body language) cues (Warkentin, Sayeed, & Hightower, 1997). For that reason, leaders can also deliver important message or information to subordinates simultaneously. Unlike traditional teams, most virtual workers may have to communicate and work synchronously or asynchronously through computer-mediated communication systems (CMCS) or such technologies as telephones, e-mail, audio/video/data conferencing, electronic voting and collaborative writing (Coleman, 1997). Therefore, the implementation of virtual collaboration will pose significant challenges for organizations, especially leadership (Kayworth & Leidner, 2001/2002).

Avolio, Kahai, and Dodge (2000) argued that the nature of leadership is fundamentally the same, whether in FtF or virtual context. Amabile, Schatzel, Moneta, & Kramer (2004) noted that in FtF teams, leadership behavior does influence subordinates perceptions, in turn, influence creativity; however, in virtual context, several researchers (e.g., Mcgrath & Hollingshead, 1994; Nunamarker, Briggs, & Mathews, 1995; Sosik, Kahai & Avolio, 1998) indicated that the role of leadership in promoting subordinates' creative performance in GDSS groups has been largely ignored. For virtual teams, information and communication technology (ICT) often limits communication media and hence provides less effective support for the group problem solving processes. Lee (1994) considered e-mail to be a rich media and was capable of supporting managers' exercise. Leaders in virtual context can lead or give their subordinates feedback through emails, even though it is not conductive to immediate feedback (Lee, 1994). For this reason, e-mail may be an appropriate communication medium, since it can delay the feedback timing, let leaders to deliberate the message they want to deliver, and determine which style and timing to unroll their leadership or feedback. As a result, leadership behavior and the leading content would be separated by the nature of virtuality, and in turn, enrolled by e-mail.

Despite the benefit of virtuality and e-mail, the research that has identified or suggested the enrolling of e-leadership behavior and the e-leading content in virtual teams remains inconsistent (Avolio, et al., 2000). For example, Purvanova and Bono (2009) compared the effects of transformational leadership in both face-to-face and virtual context and revealed that the effects of transformational leadership on team performance were stronger in virtual context. On the contrary, Kahai, Sosik, and Avolio (2003) conducted a laboratory experiment to study the effects of leadership style, anonymity and rewards on creativity-relevant group process and outcomes in electronic meeting context and revealed that transactional leadership was associated with greater group efficacy and satisfaction with the task and higher solution originality than transformational leadership.

Researchers who believe in contingency perspective states that effective leaders may adopt or change their leadership style in accordance with the nature of task and environmental condition (Lee-Kelley, 2005). As Hersey and Blanchard (1982) originally proposed, situational leadership theory predicts an optimal combination between leadership style (relationship-focus and task-focus) and subordinate attribute. Thompson & Vecchio (2009) proposed that there will be a three-way interaction that represents the relationship between leader considerateness, leader structuring, and follower developmental level in account for the follower outcomes of job performance and attitudes. Although they could not find a robust evidence to support the above most widely-known Situational Leadership Theory (SLT); however, some major textbooks still noted several distinct strengths that SLT possesses (Northouse, 2007). By following the contingency perspective, this study tried to adapt the guidelines proposed by SLT to virtual context and explored the leadership effectiveness under match and mismatch scenarios.

Leadership research in virtual context

The virtualization of work environments is supported by emerging collaboration technologies and driven by a global workforce that is required to handle complex tasks. Therefore, communications among team members can easily get side tracked and people involved often lack clear understanding of why certain things happened and how decisions were made (Warkentin et al., 1997). In addition, information is not shared immediately and interpretation of information is often distorted (Kayworth & Leidner, 2001/2002). Many researchers have found that leadership plays a very important role in the effective functioning of virtual collaboration (Hiltz & Turoff, 1976, 1985; Hiltz, Dufner, Holmes, & Poole, 1991), especially in the creation and interpretation of advance information technology (Avolio, et al., 2000). On top of paying attention to work environments and organizational climate, leaders also need to coordinate project tasks and facilitate the group process to achieve teams' goals (Kayworth & Leidner, 2001/2002). In addition, they also believe that effective leaders in virtual context would exhibit higher levels of behavioral complexity than leaders of face-to-face condition (Kayworth & Leidner, 2001/2002).

In virtual context, leaders can use email or other means to convey the expectations and requirements to subordinates by specifying how their performance will be measured and rewarded (Bass & Avolio, 1990). If subordinates are found not contributing to the required works, warning messages will be sent to them hoping that their improper behaviors may be

corrected. Kayworth & Leidner (2001/2002) created 13 virtual teams, each composed of 5 to 7 members from 3 universities, they found that the most effective leaders were those who communicated regularly, answered team member questions, provided feedback, gave directions, and approached the members with a cordial yet assertive tone. Besides, they found that virtual team leaders were very effective when they acted in a mentoring role and exhibited a high degree of understanding (empathy) toward their team members. Thus, leaders in virtual context should be sensitive to work schedules, care for all subordinates, appreciate their subordinates' opinions and suggestions, and communicate to their subordinates. For example, Sosik, Kahai, and Avolio (1998) conducted an empirical study of the effect of transformational and transactional leadership on team creativity when an anonymous electronic brainstorming tool was used. In this study, 159 college students formed 36 groups. Results showed that there is a positive correlation between transformational leadership and creativity.

Kayworth & Leidner (2001/2002) proposed some guidelines for effective leaders. For instance, leaders have to exhibit a high degree of understanding (consideration) toward their team members, care for all members, and appreciate their team members' opinions and suggestions. They also have to monitor or lead their team members follow the initial guidelines. However, how leaders behave themselves in accordance with the above principles still under explored, especially in virtual context. According to information richness theory, communication media vary in the capacity to process rich information and face-to-face (FtF) is the richest one (Daft & Lengel, 1986). Nevertheless; in virtual context, workers are geographically dispersed and have to coordinate their tasks across different time zones. Consequently, they have no choice but to seek for other media instead of FtF meeting to support their daily work, and e-mail seems the most commonly used channel for communication among dispersed heterogeneous team members (DeSanctis, Wright, & Jung, 2001).

Although Daft & Lengel (1986) argued that e-mail is a lean medium because it lacks the capability for immediate feedback, uses only a single channel, tends to be impersonal, and incurs a reduction in language variety, Lee (1994) indicated that richness or leanness is not an inherent property of the e-mail medium but an emergent property of the interaction of the e-mail medium with its organizational context. Team leaders can actively lead their team members through delivering meaningful messages in e-mail (Lee, 1994). However, what leadership style should leaders express in accordance with the control mechanism through email in virtual context is worth of further investigation.

Leadership style and control mechanism in virtual context

Studies have found that leadership styles in fact have impacts to the creativity of individual, particularly transformational leadership has more positive impact to many crucial outcome variables (Avolio, Bass, & Jung, 1999). Transformational leadership may improve subordinates interactions and trust; moreover, it can also encourage subordinates to share ideas or knowledge with each other. Kayworth & Leidner (2001/2002) also indicate that the leaders who simply demand their team members to finish the task without providing encouragement and response may lead the team into an unstable process and mediocre performance. In addition, Sosik, Kahai & Avolio (1998) conducted an empirical study of the effect of transformational and transactional

leadership on team creativity when an anonymous electronic brainstorming tool was used. There were 159 college student subjects in 36 groups. The result showed that transformational leadership will encourage the followers to challenge status quote and antiquated methods when their leaders motivate them intellectually. They will discover new issues and problems to fulfill their curiosity and imagination.

In addition to the leadership style, the control mechanism in virtual context is also vital to the leaders (Piccoli & Ives, 2003; Piccoli, et al., 2004). Piccoli & Ives (2003) divided the control mechanism into process-oriented and outcome-oriented. The process-oriented focused on the designing and structuring of working process. The outcome-oriented; however, focused on how leaders controlled their subordinates performed in the end (Ouchi, 1977, 1979; Piccoli & Ives, 2003; Snell, 1992). Purvanova & Bono (2009) indicated that the contextual effects may not be the same for all leaders, in other words, leaders may alter their leadership style to match the context. According to the perspective of personal trait, leaders may not expect to behave different style across situations. Interestingly, some studies testing the above consistency-specificity behavior leads to confounding results. Some researches stated that leaders behave consistently across situations (e.g., Albright & Forziati, 1995; Zaccaro, Foti, & Kenny, 1991); however, others found that leaders behave vary by context (Barrow, 1976; James & White, 1983). Based on the above discuss, this study expected that leaders in virtual context will vary their style in accordance with the specific control mechanism. In this case, leaders in virtual context will alter their leadership style to adapt to the situation. However, there were no previous evidences had clearly illustrated the relationship between leadership style and control mechanism, especially in the virtual setting. Thus, the purpose of the present study is tried to address this issue by investigating the consequences of leadership styles (transactional vs. transformational) and control mechanism (process-oriented vs. outcome-oriented) in virtual context and further examining how the subordinates feel if leaders changed their leadership style, both in the match or mismatch conditions.

METHODS

Sample

Undergraduate students enrolled in management accounting courses (n = 70) and human resource management courses (n=61) at two private university, located in central and north Taiwan, participated in this experiment for 20% course credit, respectively. Participants were randomly assigned to 32 four-to-five-member virtual teams. These teams were assigned as (Kahai, et. al., 2003) which had no prior interaction or co-operation experience or any expectation of future interaction. In the case of some groups, there were some participants not showing up for the online discuss every day, from the first week till the sixth week. Thus, only 114.participants contained for the further analysis. The average team size was 3.56.

Task Assignment

Each team was assigned to serve as a consulting team and asked to solve the same consulting project. For the project assignment, team members had to read the assigned management case,

developed by Wu, Hsieh, and Wan (2008), collected by Taiwan Management case center (TMCC). In addition, the confederates (served as team leader) were asked to use transformational or transactional leadership style with process-oriented or outcome-oriented control mechanism to manage their team member in accordance with their discussion. Participants were asked to follow their leader's direction to participate 6 weeks online meeting and discuss about "How to revise the performance evaluation system based on the balance score card perspective," supported by a Web-based group decision support system to complete their teamwork (consulting project) during 6 weeks. After the experiment, they are required to submit a five-to ten-page report.

Research Design

This study used a 2 (transformational/transactional) x 2 (constant/change) x 2 (process-oriented/outcome-oriented) factorial repeated-measures design, with style change used as a within-groups factor. The experimental groups were randomly assigned across the leadership and control conditions while ensuring even distribution. There were 4 groups in every Leadership x Control cell. Each group discussed the same consulting project within two stages: on in the first fifteen days (before leadership change) and the other in the following nineteen days (after leadership change). The number of participants in this study did not permit perfectly counterbalancing across leadership and control conditions. The effects of each participants' effort and how they value this research were controlled statistically.

Research assistants (served as confederate leaders) set up all agendas in advance and ask all participants to receive a one week period creative support system training to ensure that they were all familiar with the Teamspirit system. After training, all participants were asked to participate in 5 related meetings during 6 weeks by using Teamspirit to support their teamwork, and requested to submit a 5-10-pages final report in the end.

The confederates led the task exhibiting transformational or transactional leadership style in accordance with process-oriented or outcome-oriented control. The instructions and descriptions email consisting of some behavioral comments representing transformational or transactional leadership styles were formed based on the literature regarding the transformational and transactional leadership theory (Avolio, et. al., 1999; Kahai, et. al., 2003). Before participants discussed online, the confederates typed their scripted comments into the leading email and delivered to each participants at assigned times, which were different across process-control or outcome-control conditions. For the manipulation on control mechanism, based on Piccoli & Ives (2003), to manipulate the process-oriented control condition, the confederates typed their comments in advance and email to the participants to inform or notify whether they perform will or not in the online discussion every day. As to the manipulation of outcome-oriented control condition, the confederates only informed the participants how to discuss online on Monday and notify the participants to finish their online discussion on Thursday.

According to previous virtual team leadership studies (e.g., Hambly, et. al., 2007; Kahai et., al., 2003), the transformational leader's instructions and comments emphasized understanding and appreciating each participants' needs and viewpoints within group, and stimulating each other's

efforts to be creative and constructive by proposing questions, sharing new ideas, and approaching old situations in new ways (Kahai et., al., 2003). The transactional leader's instructions and comments emphasized what the group was expected to do and the rewards or punishments (course credits) it would receive on when they finishing their discussion and achieving the expected performance (Kahai et., al., 2003). After the first fifteen days' discussion, some participants under leadership change conditions will received their confederates change their leadership style from transformational into transactional or from transactional into transformational, started from the sixteen days till end. In addition, no matter under what conditions, the control mechanism will keep constant. After the five weeks online discussion, participants were asked to submit a five-to-ten pages report.

TABLE 1 Experimental Design

			Control Mechanism	
			Process-oriented	Outcome-oriented
Leadership Style	Constant	TF to TA	EG 1 (4 groups)	EG 5 (4 groups)
		TA to TF	EG 2 (4 groups)	EG 6 (4 groups)
	Change	Transformational (TF)	EG 3 (4 groups)	EG 7 (4 groups)
		Transactional (TA)	EG 4 (4 groups)	EG 8 (4 groups)

Measures

Manipulation checks. Individual-level of questionnaire items were employed to check the leadership, the leadership style change, and control mechanism manipulations. The leadership manipulation was checked using 5-point scale items ranging from "5 = strongly agree" to "1 = strongly disagree" adapted from the revised MLQ-5X (Avolio, et al., 1999). Perception of transformational leadership was measured with a 13-item scale and the perception of transactional leadership was measured with a 5-item scale. Since one of the primary goal of this study was to investigate whether the subordinate will perceive the change on leadership style, this research conducted six times measures from the beginning to the sixth week, with 5-point "strongly agree" to "strongly disagree" response format. The coefficient alpha of transformational leadership style form the first measure to the sixth measure were ranged from .82~.91. The coefficient alpha of transactional leadership style form the first measure to the sixth measure were ranged from .83~.95. In addition, the leadership style change was checked by comparing the subordinates' 6-times perception on the transformational and transactional leadership style.

The manipulation check on the control mechanism was measured not only by asking the participants how many times did they receive the email from their leaders within a week but also asked what is the main concern of their leader, focus on process or focus outcome? *Where 1 = absolutely outcome, 2 = not sure, 3 = absolutely process*.

Leadership effectiveness. This research followed Conger, Kanungo, and Menon (2000), used reverence for the leader (REV), trust in the leader (TRU), and satisfaction with the leader (SAT) to assess the leadership effectiveness. The REV was measured by a three-item scale developed by Conger, et. al. (2000). The TRU was measured by a three-item scale and was taken from Bass (1985) and Bulter (1991). SAT was also measured by three items based on Bass (1985). Since our purpose was to investigate whether the subordinate will perceive the change on leadership style and examined the effects of leadership change on leadership effectiveness, this research conducted six times measures from the beginning to the sixth week, with 5-point "strongly agree" to "strongly disagree" response format. The coefficient alpha of REV form the first measure to the sixth measure were ranged from .78~.86. The coefficient alpha of TRU form the first measure to the sixth measure were ranged from .80~.89. The coefficient alpha of SAT form the first measure to the sixth measure were ranged from .87~.95.

Web-based group problem solving system: Teamspirit

The design and structuring of group decision processes have been shown to be an important element for teams, particularly distributed ones to succeed. We have designed and implemented a Web-based problem-solving system, i.e., a Web-based GDSS in this study, called TeamSpirit. It was specifically designed according to group problem solving processes (identify problems, create/design solutions, implement solutions or systems) and techniques and was intended to be used by members of virtual teams to support their creative problem solving processes over the Web (Chen, Liou, Wang, Fan, & Chi, 2007). Each problem solving process should follow the next three stages, idea generation, idea consolidation, and idea evaluation, besides, each stage was designed some implement tools to support divergent and convergent thinking in the creative problem solving process.

The teamspirit closely followed the Creativity Problem Solving (CPS) processes and tools commonly used in general problem solving and decision making developed over time. The CPS program was initially developed by Osborn (1963) and later modified by many other researchers (e.g., Torrance et al., 1978; Isaksen et al., 1994, 2000). It is a complete program based on such a tripartite model of creative process. The key concept of the CPS is to separate the idea generation stage from the idea evaluation stage so that bizarre, uncommon ideas may have a chance to enter into our attention before they are pruned out. Facilitators and participants only need to use Web browsers to manage meetings or participate in meetings. TeamSpirit is developed in ASP.NET using Visual Basic .NET as the implementation language. The TeamSpirit system can be deployed on a computer running Microsoft Windows 2003 Server with Internet Information Server (IIS) and Microsoft .NET Framework SDK installed.

RESULTS

Table 2 and 3 present scale means and standard deviations among each experimental condition for the measures of leadership style and leadership effectiveness.

Manipulation checks

Individual-level responses to the leadership, style change, and control mechanism items were analyzed with ANOVA. The results revealed that participants led by transformational leadership perceived significantly higher level of transformational leadership style, whether before style change ($M = 3.65$ vs. 3.04, $p < .001$) or after style change ($M = 3.48$ vs. 3.10, $p < .01$). On the contrary, participants led by transactional leadership perceived significantly lower level of transformational leadership style, whether before style change ($M = 2.97$ vs. 3.35, $p < .001$) or after style change ($M = 2.93$ vs. 3.39, $p < .001$).

Perceptions of receiving leaders' email during week 2 to week 6 were significantly more in the process-oriented control condition than in the outcome-oriented condition ($M = 1.98$~2.98 vs. $M = 1.71$~1.94, $p < .001$). In addition, the perceptions of the main concern of their leader during week 2 to week 6 were significantly higher in the process-oriented control condition than in the outcome-oriented condition ($M = 2.01$~2.52 vs. $M = 1.61$~2.14, $p < .05$).

TABLE 2 Cell means, standard deviations for leadership style

Leadership				Style change				Style constant			
				TF to TA		TA to TF		Transformational (TF)		Transactional (TA)	
Control mechanism				P	O	P	O	P	O	P	O
Experiment design				EG1	EG2	EG3	EG4	EG5	EG6	EG7	EG8
Transformational	before	1st	M	3.65	3.61	3.20	2.94	3.65	3.67	2.95	3.07
			SD	.48	.61	.52	.49	.46	.40	.61	.80
		2nd	M	3.56	3.23	3.07	3.06	3.51	3.26	3.18	2.95
			SD	.70	.56	.51	.52	.46	.81	.76	.67
		3rd	M	3.36	3.25	3.51	3.55	3.54	3.42	3.10	2.94
			SD	.37	.43	.76	.79	.44	.51	.59	.76
	after	4th	M	3.28	3.10	3.57	3.68	3.30	3.38	2.99	3.01
			SD	068	.72	.67	.48	.57	.69	.76	.69
		5th	M	3.37	3.19	3.39	3.62	3.29	3.37	3.08	3.26
			SD	.47	.72	.54	.54	.43	.96	.56	.62
		6th	M	3.36	3.35	3.44	3.49	3.48	3.41	3.08	3.19
			SD	.57	.60	.62	.51	.45	.51	.68	.62
Transactional	before	1st	M	3.28	2.91	3.37	3.13	2.73	2.91	3.51	3.41
			SD	.44	.52	.42	.48	.50	.62	.53	.48
		2nd	M	2.87	2.94	3.35	3.35	2.77	2.57	3.23	3.48
			SD	.55	.52	.52	.48	.38	.50	.55	.44
		3rd	M	3.11	3.13	3.39	3.57	2.70	3.07	3.31	3.42
			SD	.44	.51	.47	.54	.56	.32	.52	.63
	after	4th	M	3.29	3.53	3.22	3.17	2.62	2.72	3.46	3.29
			SD	.58	.39	.54	.62	.57	.58	.59	.63
		5th	M	3.30	3.35	3.13	3.35	2.91	2.63	3.30	3.30
			SD	.48	.47	.52	.63	.44	.82	.45	.54
		6th	M	3.14	3.41	3.14	3.28	2.84	2.85	3.39	3.30
			SD	.59	.33	.55	.61	.56	.52	.51	.55

TABLE 3 Cell means, standard deviations for leadership effectiveness

Leadership				Style change				Style constant			
				TF to TA		TA to TF		TF to TA		TA to TF	
Control mechanism				P	O	P	O	P	O	P	O
Experiment design				EG1	EG2	EG3	EG4	EG5	EG6	EG7	EG8
REV	before	1st	M	3.46	3.59	3.45	3.57	3.67	3.51	3.44	3.65
			SD	.37	.37	.65	.57	.53	.69	.38	.55
		2nd	M	3.21	3.29	2.90	3.41	3.18	3.05	3.16	3.27
			SD	.45	.40	.49	.68	.37	.83	.55	.37
		3rd	M	3.35	3.09	3.37	3.32	3.45	3.28	3.06	2.85
			SD	.66	.42	.50	.66	.59	.82	.29	.58
	after	4th	M	3.22	3.25	3.36	3.19	3.15	3.33	3.18	3.59
			SD	.42	.35	.62	.27	.54	.62	.29	.51
		5th	M	3.21	3.29	3.25	3.43	3.23	3.18	3.15	3.68
			SD	.56	.38	.51	.42	.57	.60	.40	.54
		6th	M	3.14	3.25	3.35	3.19	3.26	3.33	3.11	3.71
			SD	.53	.32	.71	.32	.51	.72	.52	.47
TRU	before	1st	M	3.32	3.19	3.21	3.46	3.64	3.35	3.28	3.42
			SD	.36	.45	.55	.42	.61	.40	.40	.38
		2nd	M	3.10	2.82	2.91	3.27	3.10	2.79	2.98	3.08
			SD	.33	.62	.33	.34	.55	.70	.62	.40
		3rd	M	3.10	2.83	2.78	2.81	3.42	2.74	.2.68	3.22
			SD	.55	.87	.34	.56	1.22	.85	.59	.64
	after	4th	M	3.22	3.31	3.55	3.31	3.15	3.21	3.08	3.26
			SD	.35	.44	.56	.76	.75	.74	.74	.80
		5th	M	3.03	3.24	3.30	3.16	3.04	3.10	2.89	3.31
			SD	.51	.39	.58	.76	.69	.92	.51	.75
		6th	M	2.77	3.17	2.97	2.70	2.95	3.20	2.89	3.22
			SD	.71	.46	.77	1.15	.73	1.05	.76	.69
SAT	before	1st	M	3.53	3.58	3.49	3.55	3.69	3.60	3.50	3.58
			SD	.42	.63	.38	.52	.48	.58	.44	.45
		2nd	M	3.02	3.20	3.04	3.34	3.04	2.88	2.80	3.06
			SD	.40	.59	.29	.48	.54	1.15	.61	.47
		3rd	M	3.21	2.90	2.93	2.78	3.04	3.21	2.97	2.93
			SD	.56	.72	.58	.59	.51	.91	.62	.62
	after	4th	M	3.16	3.36	3.40	3.07	3.31	3.30	3.00	2.92
			SD	.58	.44	.52	.35	.69	.59	.62	.62
		5th	M	2.96	3.36	3.29	3.23	3.34	3.37	2.91	3.36
			SD	.63	.51	.50	.58	.57	.59	.79	.74
		6th	M	2.69	3.31	3.43	3.04	3.30	3.40	2.86	3.36
			SD	.70	.36	.77	1.14	.36	.47	.70	.83

The impact of leadership style, style change, and control mechanism on leadership effectiveness

Table 4 shows descriptive statistics for the leadership effectiveness in each of the cells in the study's design. MANCOVA was employed to examine the impact of leadership style, style change, and control mechanism on leadership effectiveness. The leadership (B), control mechanism (C), and style change (D), B x C, A x D, B x D, C x D, and B x C x D, were served as independent variable and the relationship between effort and course credit (A) was served as covariate and were entered simultaneously. Table 5 shows summary MANCOVA results on the reverence for the leader (REV), trust in the leader (TRU), and satisfaction with the leader (SAT).

The results showed that leadership style did moderate the effect of control mechanism on the reverence for the leader [$F(3,114) = 4.73$, $p < .01$], trust in the leader [$F(3,114) = 6.84$, $p < .001$], and satisfaction with the leader [$F(3,114) = 5.03$, $p < .01$]. Further, the MANOVA indicated a significant three-way interaction of leadership, style change, and control mechanism on the reverence for the leader [$F(3,114) = 3.51$, $p < .05$], trust in the leader [$F(3,114) = 3.03$, $p < .05$], and satisfaction with the leader [$F(3,114) = 5.47$, $p < .01$]. Figure 1 was graphic representation of the above two-way and three-way interaction. As shown in the figure, the strongest interaction relationship between leadership, style change, and control mechanism were observed. To sum up, leadership did moderate the effect of control mechanism on the reverence for the leader, trust in the leader, and satisfaction with the leader. Analysis of simple effects indicated that in the process-oriented condition, transformational leadership leads higher level of leadership effectiveness than transactional leadership. In the outcome-oriented condition, transactional leadership leads higher level of leadership effectiveness than transformational leadership. Further, if the transformational leadership in accordance with process-oriented control and the transactional leadership in accordance with outcome-oriented control are the matched conditions and the others were mismatched conditions. In this case, leaders who change their style from match to mismatch conditions did decrease the level of leadership effectiveness, and leads that changes their style from mismatch to match conditions did increase the level of leadership effectiveness. Thus, the results supported the expected relationship, that is, leaders in virtual context will vary their style in accordance with the specific control mechanism.

TABLE 4 Cell means, standard deviations for leadership effectiveness

Variable	Experiment Scenario	Process-Oriented Control					Outcome-Oriented Control				
		Before change		After change			Before change		After change		
		M	SD	M	SD	N	M	SD	M	SD	N
REV	TF to TA	3.36	.29	3.14	.45	19	3.29	.27	3.40	.39	15
	TF	3.46	.26	3.34	.59	14	3.25	.64	2.92	.83	14
	TA to TF	3.24	.34	3.31	.56	16	3.38	.53	3.21	.21	16
	TA	3.15	.33	3.06	.38	14	3.39	.36	3.81	.50	15
TRU	TF to TA	3.18	.23	2.96	.38	19	2.93	.43	3.39	.43	15
	TF	3.44	.48	3.21	.77	14	2.96	.41	2.88	.88	14
	TA to TF	2.90	.13	3.26	.58	16	3.15	.19	3.08	.73	16
	TA	2.91	.35	2.79	.57	14	3.20	.23	3.40	.73	15
SAT	TF to TA	3.28	.30	2.91	.53	19	3.21	.13	3.45	.40	15
	TF	3.34	.37	3.44	.57	14	3.25	.70	3.04	.73	14
	TA to TF	3.12	.28	3.36	.51	16	3.21	.29	3.10	.34	16
	TA	3.02	.40	2.73	.59	14	3.25	.16	3.47	.74	15

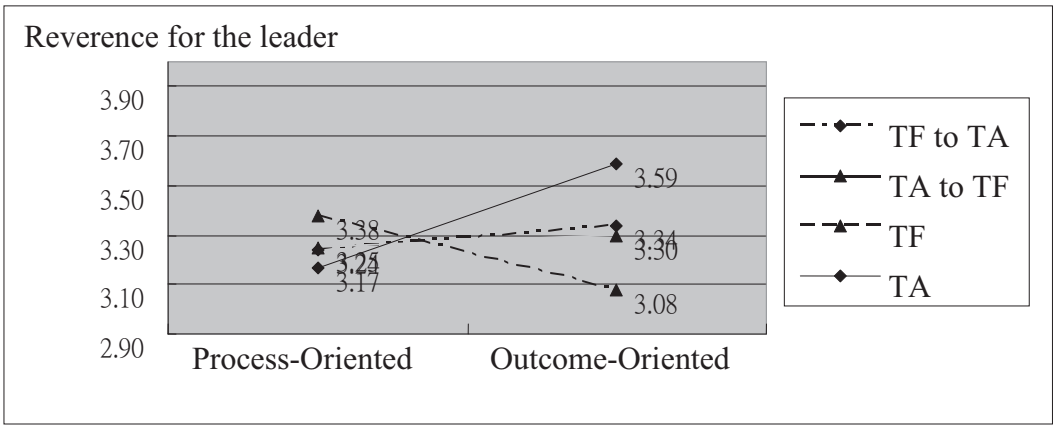
TABLE 5 MANCOVA results on leadership effectiveness

Variables	Interaction effects							
	B x C		B x D		C x D		B x C x D	
	F	*df*	*F*	*df*	*F*	*df*	*F*	*df*
Reverence for the leader	4.73**	3,114	2.89**	3,114	0.95	1,114	3.51*	3,114
Trust in the leader	6.84**	3,114	1.04	3,114	1.38	1,114	3.03*	3,114
Satisfaction with the leader	5.03**	3,114	0.31	3,114	1.09	1,114	5.47**	3,114

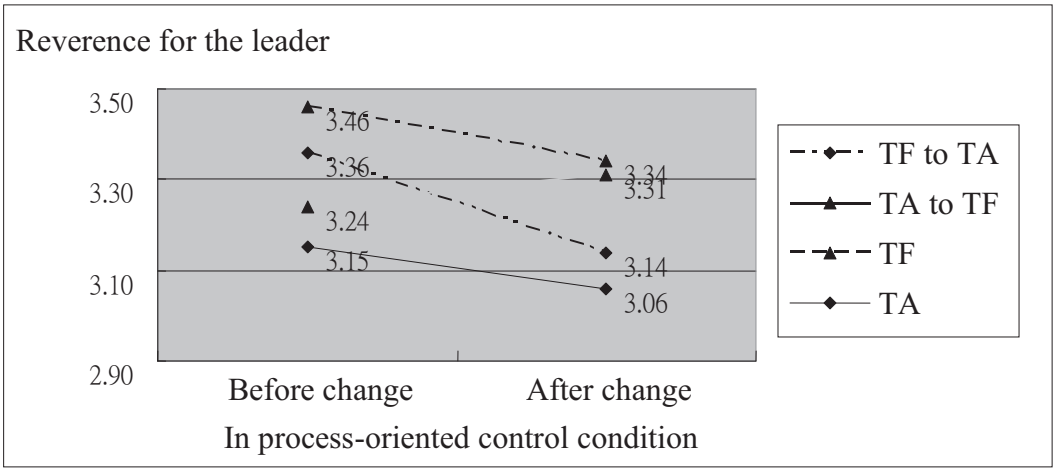
Note: (B) means leadership style; (C) means control mechanism; (D) means style change
* $p < .05$
** $p < .01$

FIGURE 1
Plots of cell means for leadership effectiveness variables

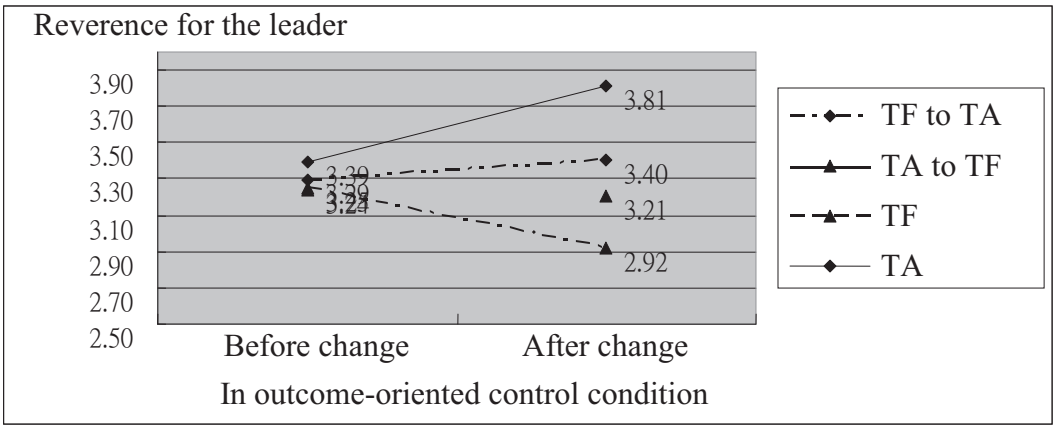
(a)



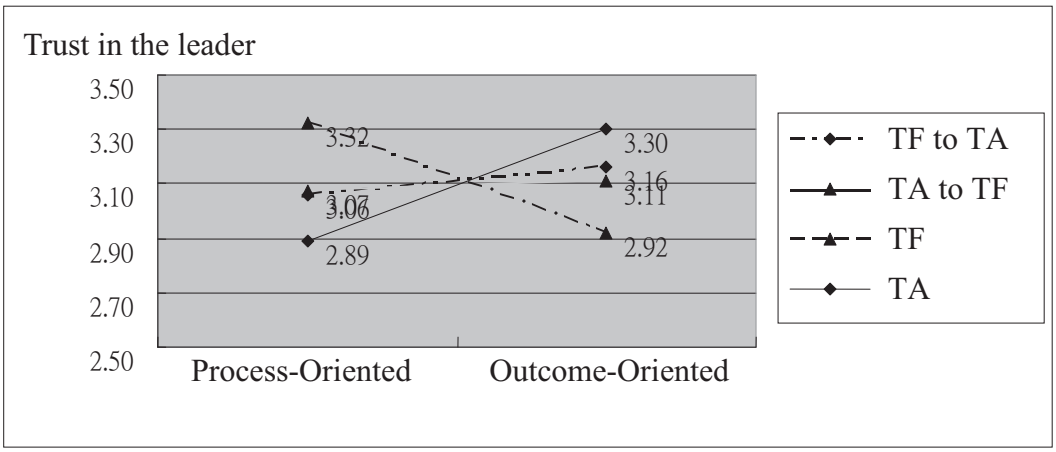
(b)



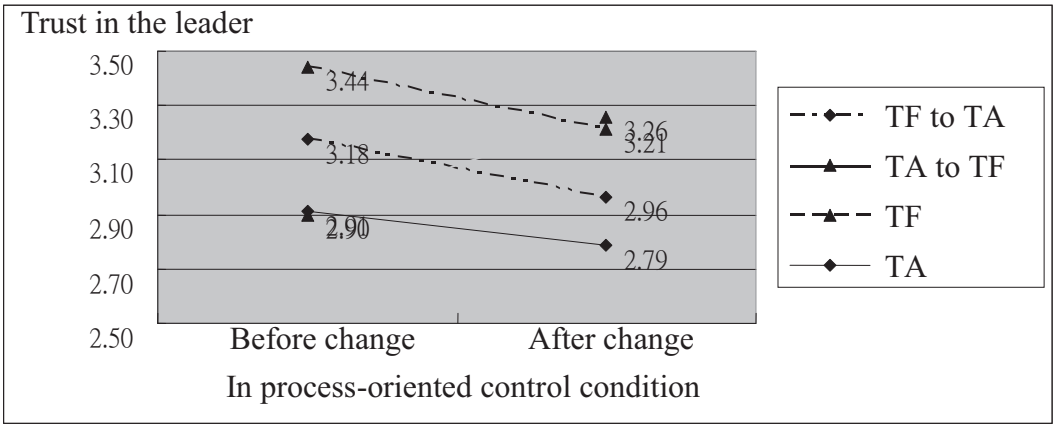
(c)



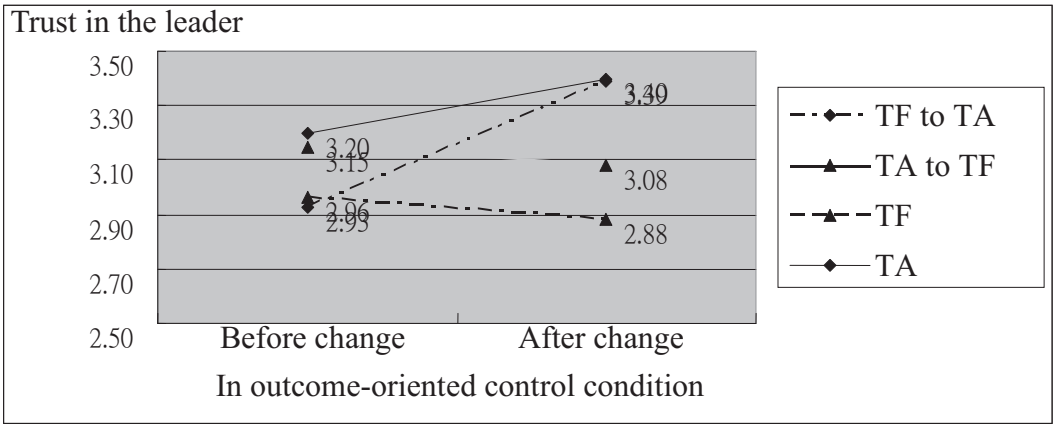
(d)


Trust in the leader
3.50
3.30
3.10
2.90
2.70
2.50
3.32
3.30
3.16
3.11
3.07
3.06
2.89
2.92
Process-Oriented
Outcome-Oriented
TF to TA
TA to TF
TF
TA

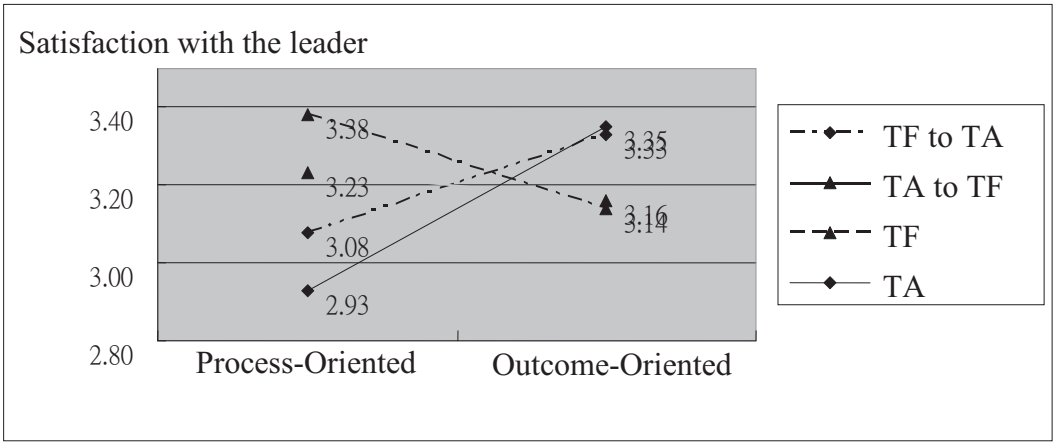
(e)


Trust in the leader
3.50
3.30
3.10
2.90
2.70
2.50
3.44
3.26
3.21
3.18
2.96
2.90
2.79
Before change
After change
In process-oriented control condition
TF to TA
TA to TF
TF
TA

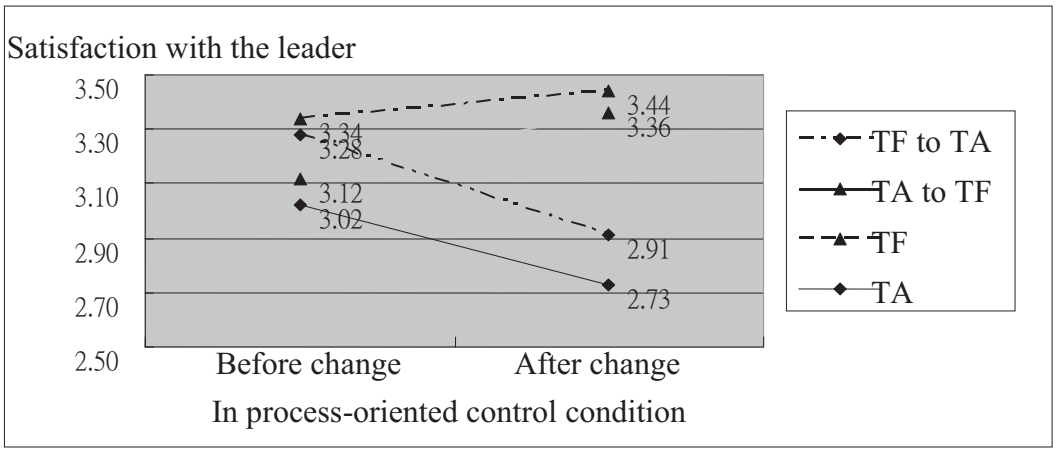
(f)


Trust in the leader
3.50
3.30
3.10
2.90
2.70
2.50
3.30
3.20
3.15
3.08
2.96
2.93
2.88
Before change
After change
In outcome-oriented control condition
TF to TA
TA to TF
TF
TA

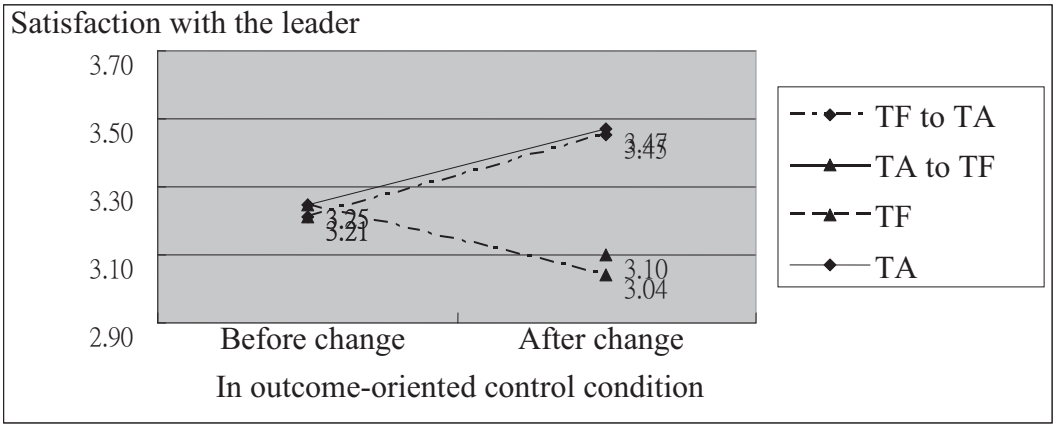
(g)


Satisfaction with the leader
3.40
3.20
3.00
2.80
3.38
3.23
3.08
2.93
3.35
3.33
3.16
3.14
Process-Oriented
Outcome-Oriented
TF to TA
TA to TF
TF
TA

(h)


Satisfaction with the leader
3.50
3.30
3.10
2.90
2.70
2.50
3.34
3.28
3.12
3.02
3.44
3.36
2.91
2.73
Before change
After change
In process-oriented control condition
TF to TA
TA to TF
TF
TA

(i)


Satisfaction with the leader
3.70
3.50
3.30
3.10
2.90
3.25
3.21
3.47
3.43
3.10
3.04
Before change
After change
In outcome-oriented control condition
TF to TA
TA to TF
TF
TA

DISCUSSIONS

The purpose of the present study tries to investigate the match and mismatch conditions between leadership styles (transactional vs. transformational) and control mechanism (process-oriented vs. outcome-oriented) in virtual context and further examining how the subordinates feel if leaders changed their leadership style, from match to mismatch conditions, and vice versa. The results show that leaders in virtual context will vary their style in accordance with the specific control mechanism. From the results, leadership style and control mechanism have impacts on leadership effectiveness. We speculate that the contingency-specific perspective and the nature of virtual context may be the major factors contributing to such findings.

Contingency-specific perspective

Early behavioral approaches to leadership suggest that effective leaders are those who engage in two basic activities: initiating structure and consideration (Bass, 1990; Rambo, 1982). Initiating structure refers to task-related activities, whereas consideration relates to the extent of care and concern for subordinates (Scott & Walker, 1995). Transformational leaders emphasize the vision and human relations aspect (consideration) of team function. They expressed great care, concern, and understanding toward members. When virtual workers perceived being understood and cared by their leaders, they felt free to express their ideas. Therefore, leaders adopt process-oriented control with transformational leadership style might lead subordinates feel that they are in a safer and more considerate environment, thus, enhance leadership effectiveness. In contrast, leaders with transactional leadership style in process-oriented condition might lead their subordinates feel pressure and uncomfortable thus decreases leadership effectiveness. In brief, this study revealed that leaders could have the flexibility in managing their subordinates in virtual context. The findings were more consistent with the previous literature on cross-situational consistency and specificity, which indicated that leaders should adapt their leadership style in response to situational demands (e.g., Hill & Hughes, 1974; James & White, 1983; Purvanova & Bono, 2009).

Nature of virtual context

Whereas virtual context undoubtedly face similar as traditional working environment, we argue that these dispersed work groups may also face unique issues. This stems from the belief that the CMCS (such as, group support systems, e-mail, internets, and intranets) used to link virtual workers across time, space, and organizational boundaries represent fundamentally new types of mediums “with their own advantages, disadvantages, social dynamics, problems, and opportunities” (Hiltz & Turoff, 1985). That virtual collaboration lack of a social context may alter or hinder the process through which virtual workers develop trust (Jarvenpaa, Knoll, & Leidner, 1998). As a result, virtual communication through CMCS may appear out of context and without focus (Warkentin, Sayeed, & Hightower, 1997), resulting in lost meanings, distortion, and misinterpretation. Workers are in such environments, they need their leaders to give them feedback, telling them what to do and telling them what have not done. Leaders through communication exhibited strong authority to achieve team goals, yet, at the same time, members were able to catch the team goal. Moreover, leaders gave the pressure to those who had not

participated or who did not perform well might push them to spend more effort to do the work. This might be the reason why transactional style in accordance with outcome-oriented control could increase subordinates show more reverence, trust, and satisfaction with the leader.

Implications

In light of the interest findings from this study, three crucial contributions were drawn. First, this study moves the current virtual leadership researches form face to face working environment to virtual context. Second, this study further specifies the discussion regarding leadership style and control mechanism. Third, this study advances the emerging study of virtual leadership by exploring the effects and the possible consequences of leadership change on the relevant outcome.

Some valuable findings have emerged from this research. First, leaders in virtual context should give some guidance or directions to their members with more concerned, understanding, and empathy wordings during the whole working process would not only increase members' willing to propose their ideas but also earn their respect, trust and satisfaction. Abundant of previous theories and empirical studies have verified that leadership styles indeed can increase leadership effectiveness whether in traditional team settings (Avolio, et al., 1999) or virtual context (Kayworth & Leidner, 2001/2002). Moreover, Jarvenpaa and Leidner (1999) have indicated that transformational leaders can build relationships among team members and to increase mutual trusts via written communications, which, in turn, is critical to team performance. However, there is little empirical study that exactly illustrates how leaders behave and motivate their members in virtual context. This research might give some hints for leaders to choose their leadership style and control oriented in virtual context.

Limitations and Suggestions

Our study has several limitations. First, since our findings are based on a limited sample, and all the subjects are all students, this may restrict our ability to generalize these results to other settings. Second, these findings may only be applicable to cultures similar to those represented by the subjects of this study, and the results may be different from global virtual teams that have members coming from many countries. Future studies should seek to identify how the characteristics of virtual leadership may vary across a variety of cultures. Third, we employed a simple assignment, whereas, in business environment, employees have to use their domain knowledge to solve more difficult problems than the assignment used in our experiment. Fourth, because our teams were comprised of different classes from the undergraduate students, subgroup formations occurred privately was possible. Such subgroup interaction might have had beneficial or negative consequences for the virtual works. We did not study the formation of subgroups, but this is another interesting area for future research.

REFERENCES

1. Albright, L. & Forziati, C. 1995. Crooss-situational consistency and perceptual accuracy in leadership. ***Personality and Social Psychology Bulletin***, 12, 1269-1276.
2. Amabile, T. M., Schatzel, E. A., Moneta, G. B., & Kramer, S. J. 2004. Leader behavior and the work environment for creativity: Perceived leader support. ***The Leadership Quarterly*****,** 15: 5-32.
3. Avolio, B. J. & Bass, B. M., & Jung, D. I. 1999. Re-examining the components of transformational and transformational leadership using the multifactor leadership questionnaire. ***Journal of Occupational and Organizational Psychology*****,** 72(4): 441-442.
4. Avolio, B. J., Kahai, S., & Dodge, G. E. 2000. E-leadership: Implications for theory, research, and practice. ***Leadership Quarterly***, 11(4): 615-668.
5. Avolio, B. J, Waldman, D. A, & Einstein, W. O. 1988. Transformational leadership in a management game simulation. ***Group and Organization Studies***, 13: 59-80.
6. Barrow, J. C. 1976. Work performance and task complexity as causal determinants of leader behavior style and flexibility. ***Journal of Applied Psychology***, 61: 433-440.
7. Bass, B. M. 1985. ***Leadership and performance beyond expectations***. New York: Free Press.
8. Bass, B. M. (1998). ***Transformational leadership: Industrial, military, and educational impact***. Mahwah, NJ: Erlbaum.
9. Bass, B. M. 1990. ***Handbook of Leadership: Theory, research, and managerial applications.*** New York: The Free Press.
10. Bass, B. M., & Avolio, B. J. 1990. ***Transformational leadership development: Manual for multifactor leadership questionnaire.*** Palo Alto, CA: Consulting Psychologists Press.
11. Bulter, J. K. 1991. Toward understanding and measuring conditions of trust: Evolution of a conditions of trust inventory. ***Journal of Management***, 17(3): 643-663.
12. Burns, J. M. 1978. ***Leadership.*** New York: Harper & Row.
13. Chen, M., Liou, Y., Wang, C. W., Fan, Y. W. & Chi, Y. P. J. 2007. TeamSpirit: The Design, Implementation and Evaluation of a Web-Based Group Decision Support System. ***Decision Support Systems*****,** 43(4): 1083-1095.
14. Coleman, D. 1997. ***Groupware: Collaborative Strategies for Corporate LANS and Intranets.*** Upper Saddle River, NJ: Prentice Hall.
15. Conger, J. A., Kanungo, R. N., & Menon, S. T. 2000. Charismatic leadership and follower effects. ***Journal of Organizational Behavior***, 21: 747-767.
16. Daft, R. L., & Lengel, R. H. 1986. Organization Information Requirements, Media Richness, and Structural Design. ***Management Science,*** 32(5): 554-571.
17. DeSanctis, G., & Poole, M. S. 1997. Transitions in teamwork in new organizational forms. ***Advances in Group Processes*****,** 14: 157-176.
18. DeSanctis, G., Wright, M., & Jung, L. 2001, Building a global learning communication. ***Communications of the ACM***, 44(12): 80-82.
19. Hambley, L. A., Neill, T. A. O., & Kline, T. J. B. 2007. Virtual team leadership: The effects of leadership style and communication medium on team interaction styles and outcomes. ***Organizational Behavior and Human Decision Processes***, 103: 1-20.
20. Hersey, P. & Blanchard, K. 1982. ***Management of Organizational Behavior***. NJ: Prentice-hall.

21. Hill, W. A., & Hughes, D. 1974. Variation in leader behavior as a function of task type. ***Organizational Behavior and Human Performance***, 11: 83-96.
22. Hiltz, S. R., & Turoff, M. 1976. ***The network nation***. Reading, MA: Addison-Wesley.
23. Hiltz, S. R., & Turoff, M. 1985. Structuring Computer-Mediated Communication Systems to avoid information overload. ***Communications of the ACM*****,** 28(7): 680-689.
24. Hiltz, S. R., Dufner, D., Holmes, M., & Poole, S. 1991. Distributes group support systems: Social dynamics and design dilemmas. ***Journal of Organizational Computing*****,** 2(1): 135-159.
25. Isaksen, S. G., Dorval, K. B., & Treffinger, D. J. 1994. ***Creative approach to problem solving.*** Dubuque IA: Kendall-Hunt.
26. Isaksen, S. G., De Schryver, L., Dorval, K. B., McCluskey, K. W., & Treffinger, D. J. 2000. ***Facilitative leadership: Making a difference with creative problem solving.*** Buffalo NY: Creative Problem Solving Group.
27. James, L. R., & White, J. F., III. 1983. Cross-situational specificity in managers' perceptions of subordinate performance, attributions, and leader behaviors. ***Personnel Psychology***, 36: 809-856.
28. Jarvenpaa S. L., Leidner D. E., & Pearlson, K. 1995. Global Customer Service for the Computer and Communications Industry. Palvia, P. C., Palvia, P. C., Roche, E. M. ed., ***Global Information Technology and Systems Management.*** Ivy League Publishing. Harrisburg, PA.
29. Jarvenpaa, S. L., Knoll, K., & Leidner, D. E. 1998. Is anybody out there? Antecedents of trust in global virtual teams. ***Journal of Management Information Systems,*** 14(4): 29-64.
30. Jarvenpaa, S. L., & Leidner D. E. 1999. Communication and trust in global virtual teams. ***Organization Science*****,** 10(6): 791–815.
31. Kahai, S. S., Sosik, J. J., & Avolio, B. J. 2003. Effects of leadership ltyle, anonymity, and rewards on creativity-relevant processes and outcomes in an electronic meeting system context. ***Leadership Quarterly***, 14(4-5): 499-524.
32. Kayworth, T. R., & Leidner, D. E. 2001-2002. Leadership effectiveness in global virtual teams. ***Journal of Management Information Systems*****,** 18(3): 7-41.
33. Lee, A. E. 1994. Electronic mail as a medium for rich communication: An empirical investigation using hermeneutic interpretation. ***MIS Quarterly***, 18(2): 145-157.
34. Lee-Kelley, L. 2005. Situational leadership: Managing the virtual project team. ***Journal of Management Development***, 21(6): 461-476.
35. Lipnack, J., & Stamps J. 1997. ***Virtual teams: Reaching Across Space, Time and Organization with Technology.*** New York: John Wiley & Sons, Inc.
36. McGrath, J. E., & Hollingshead, A. B. 1994. ***Groups interacting with technology: Ideas, evidence, issues and an agenda.*** London: Sage.
37. Northouse, P. G. 2007. ***Leadership: Theory and practice***. Thousand Oaks, CA: Sage Publications.
38. Nunamarker, J. F., Briggs, R. O., & Mathews. D. D. 1995. Electronic meeting systems: Ten years of learned lessons. In D. Coleman & R. Khanna (Eds.), ***Groupware: Technology and application*** (pp. 149-193). Englewood Cliffs, NJ: Prentice Hall.
39. Ocker, R. J. 2005. Influences on creativity in asynchronous virtual teams: A qualitative analysis of experimental teams. ***IEEE Transactions on Professional Communication,*** 48: 22-39.

40. Osborn, A. F. 1963. ***Applied imagination.*** New York: Scribners.
41. Ouchi, W. G. 1977. The relationship between organizational structure and control. ***Administrative Science Quarterly,*** 22(1): 95-112.
42. Ouchi, W. G. 1979. A conceptual framework for the design of organizational control mechanisms. ***Management Science***, 25(9): 833-848.
43. Piccoli, G. & Ives, B. 2003. Trust and the unintended effects of behavior control in virtual teams. ***MIS Quarterly***, 27(3): 365-395.
44. Piccoli, G., Powell, A., & Ives, B. 2004. Virtual teams: Team control structure, work processes, and team effectiveness. ***Information Technology & People***, 17(4): 359-379.
45. Powell, A., Piccoli, G.., & Ives, B. 2004. Virtual teams: A review of the current literature and directions for future research. ***The DATA-BASE for Advances in Information Systems,*** 35(1): 6-36.
46. Purvanova, R. K. & Bono, J. E. 2009. Transformational leadership in context: Face-to face and virtual teams. ***The Leadership Quarterly***, 20: 343-357.
47. Rambo, W. W. 1982. ***Work and organizational behavior.*** New York: CBS College Publishing.
48. Shin J. S. & Zhou J. 2003. Transformational Leadership, conservation, and creativity: Evidence from Korea. ***Academy of Management Journal,*** 46: 703-714.
49. Snell, S. A. 1992. Control theory in strategic human resource management: the mediating effect of administrative information. ***Academy of Managoment Journal***, 35(2): 292-327.
50. Sosik, J. J., Kahai, S. S. & Avolio, B. J. 1998. Inspiring group creativity. ***Small Group Research,*** 29(1): 3-31.
51. Stott, K., & Walker, A. 1995. ***A teams, teamwork, and teambuilding.*** Singapore: Prentice Hall.
52. Tompson, G. & Vecchio, R. P. 2009. Situational leadership theory: A test of three versions. ***The Leadership Quarterly***, 20: 837-848.
53. Torrance, E.P., Torrance, J. P., Willams, S. J., Horng, R. Y., & Crable, A. B. 1978. ***Handbook for training future problem solving teams.*** Lincoln NE: Future Problem Solving Bowl.
54. Townsend, A., DeMarie, S. & Hendrickson, A. (1998). Virtual Teams: Technology and the Workplace of the Future. ***Academy of Management Executive,*** 2(3): 17-29.
55. Warkentin, M. E., Sayeed, L., & Hightower, R. 1997. Virtual teams vs. face to face teams: An exploratory study of a web-based conference system. ***Decision Sciences,*** 28(4): 975-976.
56. Wu, A. N., Hsieh, S. F., & Wan, B. J. 2008. 恆光化學股份有限公司. ***Taiwan Management Case Center***, No: AR0000821.
57. Yammario, F. J. & Bass, B. M. 1990. Transformational leadership and multiple level of alalysis. ***Human Relations***, 43: 975-995.
58. Zaccaro, S. J., Foti, R. J., & Kenny, D. A. 1991. Self-monitoring and trait-based variance in leadership: An investigation of leader flexibility across multiple group situations. ***Journal of Applied Psychology***, 76, 308-315.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

EVALUATING ACCURACY OF A TIME ESTIMATOR IN A PROJECT

Thanh-Lam Nguyen, Graduate Institute of Mechanical and Precision Engineering
National Kaohsiung University of Applied Sciences, Kaohsiung 80778, Taiwan

Wei-Ju Hung, Department of Industrial Engineering and Management
National Kaohsiung University of Applied Sciences, Kaohsiung 80778, Taiwan

Ming-Hung Shu, Department of Industrial Engineering and Management
National Kaohsiung University of Applied Sciences, Kaohsiung 80778, Taiwan

Lin-Ying Hsu, Department of Industrial Engineering and Management
National Kaohsiung University of Applied Sciences, Kaohsiung 80778, Taiwan

Yueh-Hung Yeh, Department of Industrial Engineering and Management
National Kaohsiung University of Applied Sciences, Kaohsiung 80778, Taiwan

ABSTRACT

Purpose: *Each activity in a project must be clearly defined and specified with when to start, how much time is required for completion and when to finish. It is vital that the time estimates for each work obtained be realistic in order to produce a good schedule for meeting deadlines and avoiding unnecessary project costs. This paper aims at evaluating the effectiveness and accuracy of the time estimator.*
Design/Methodology/Approach: *As tracking signal, a widely used method in forecasting domain, has alarming ability in detecting structural changes in time series by responding to out-of-control signals, it is, therefore, strongly suggested to be employed in monitoring the time estimation of critical tasks, through which the effectiveness and accuracy of the time estimator is accordingly evaluated.*
Findings: *In this paper, it was found that although the total time of a project was well estimated and met, the quality of the time estimation was still not good enough. Therefore, the estimator must take special attention to assign more realistic time and more appropriate personnel in the critical tasks that were detected out-of-control. By doing this way, he/she can perform his/her job better and get to know the employees better and better.*
Originality/Value: *Though tracking signal has been widely used in monitoring the performance of a forecasting model, it is the first time in this paper that it is addressed to be used in evaluating the accuracy of a job performance.*

Keywords: Time estimation, accuracy evaluation, monitoring critical tasks

INTRODUCTION

Project management in the business and industry fields is defined as managing and directing time, materials, personnel and costs to complete a particular project in an orderly economical manner and to meet established objectives of time, cost and technical results (Spinner, 1992). The management usually involves in using one or several techniques such as network planning, cost analysis, personnel allocation, and management by objectives, etc. Among

them, network planning has been considered the most popular (Spinner, 1992). Usually being used to plan, schedule and control a project consisting of a group of interrelated activities, network planning is especially useful for those projects which have a well-defined starting point and a well-defined objective. It has several applications in practice, for example, construction projects, administrative programs, maintenance operations and any other series of activities that, when combined, can form a complete program with a start and a finish (Spinner, 1992).

There are three phases in the project management cycle: planning, scheduling and control. In planning phase, it is critical to determine what activities must be done in completing a project, their sequence and interrelations which are then often presented on an arrow diagram; whereas, in the scheduling phase, timing aspects of each work are carefully considered. Each activity must be specified with when to start, how much time is required for completion and when to finish. It is vital that the time estimates for each work obtained be realistic in order to produce a good schedule for meeting deadlines and avoiding unnecessary project costs. The time estimates can be either done along with the initial diagram to make proper adjustments based on pre-defined objectives or modified after the project begins to identify if there is a delay in the work that will extend the duration of the project or the work is progressing faster than expected.

The network diagram normally uses a single time for each work. The time estimate, usually determined by an experienced person, is the amount of time that the work will require under a specified set of conditions. As suggested based on personal experience, the estimate is usually biased and may be higher. In order to offset this bias, three time estimates, including optimistic, normal and pessimistic, are used to create one time estimate as per the equation (1).

$$Time\ estimate = \frac{Optimistic\ time + 4 * Normal\ time + Pessimistic\ time}{6} \quad (1)$$

Normal time is the time that would be most frequently required if the work were repeated many times under the similar conditions. While optimistic time is the shortest possible time required for completing a work under the assumption that everything goes one as planned, for instance, material deliveries are on time as scheduled, machines operate without major breakdowns, personnel perform work within work standard, etc., pessimistic time is the maximum possible time required for completing the work in the worst situations; particularly, delayed deliveries, accidents, bad weather, and so on (Spinner, 1992).

Spinner (1997) pointed out that the three-estimate approach can cause the expected time to be biased toward the pessimistic time which is usually overly pessimistic; thus, the method is used only when the results from one time estimate are probably unrealistic.

Once a project is carefully planned and scheduled, monitoring its activities is of importance to keep it under control. By comparing the start and finish schedule with the actual performance, certain warning signals may arise for further investigation and corrective actions. Some activities may be behind schedule and some may be ahead. In order to compensate the lateness in some activities to keep the project on target, there is frequently an effort to adjust the timing of other critical ones which may lead to a certain revision of the

entire project plan depending on the severity of the timing problem. However, when critical jobs are finished ahead of schedule, future critical ones need checked and rescheduled if required. These are the fundamentals of monitoring a project performance. Therefore, it can be said that good estimates reflect not only the capability and level of experience of the in-charge person but also his/her level of knowing the actual ability of the employees' performance and result in less adjustment in the schedule during the project cycle. But, there has hardly been any research in evaluating how good the time estimates for the whole project are as well as how efficient the performance of the employees is. Thus, this paper aims at using tracking signals to evaluate the effectiveness and accuracy of the estimator in terms of assigning time estimates.

This paper is organized as the following. Section 2 discusses the use of tracking signals. An empirical study is presented in Section 3 to illustrate the applicability of tracking signals. Conclusion makes up the last section.

REVIEWS ON TRACKING SIGNAL

In monitoring the forecast errors, tracking signal is usually employed due to its alarming ability in detecting structural changes in time series by responding to out-of-control signals (Snyder and Koehler, 2006). Providing accurate and unbiased estimate is the ultimate endeavor of any forecasting issues (Wisner et al., 2008; Chary, 1995). Inaccurate and/or biased estimate is one of the main factors making substantial increase in both operational and opportunity costs to the involved organizations that use the forecast result being significantly different from the actual figure. Forecast error is actually the difference between the observed and the forecast as expressed in equation (1).

$$\varepsilon_t = OV_t - FV_t \tag{1}$$

where ε_t, OV_t and FV_t respectively denote the forecast error, the observed value and the forecast value at the period t.

Forecast bias, the tendency of a forecast to be consistently higher or lower than the actual can be expressed in cumulative forecast error (CFE) and mean absolute deviation (MAD), shown in equation (2). They are two among several indexes usually used to measure the forecast accuracy (Wisner et al., 2008).

$$\begin{aligned} CFE_t &= \sum_{i=1}^{t} \varepsilon_i \\ MAD_t &= \left(\sum_{i=1}^{t} |\varepsilon_i| \right) / t \end{aligned} \tag{2}$$

The ratio between CFE and MAD is named as tracking signal (TS) which was developed by Page (1955). It is a widely used tool to check the forecast bias (Wisner et al., 2008; Wallace and Stahl, 2002). Several scholars have thoroughly accessed and improved it (Gardner, 1985; Li et al., 2012). Brown (1959) suggested a new definition of the tracking signal by defining it as the quotient between the simple cumulative sum of errors and the simple smoothed MAD. The Brown's tracking signal (BTS), given in equation (3), is commonly employed in practice nowadays (Li et al., 2012).

$$BTS_t = CFE_t / SMAD_t \quad (3)$$

where $SMAD_t = \alpha|\varepsilon_t| + (1-\alpha)SMAD_{t-1}$ denotes the simple smoothed MAD at the period t. In the denotation, α is a smooth parameter $(\alpha \in [0,1])$ and the initial value SMAD is assumed to be zero (Chary, 1995).

By using tracking signal, forecast errors can be efficiently monitored with a control chart with two control limits (upper and lower) which represent the track where the errors should go (Mele et al., 2001). If a signal falls outside the control limits, the forecast is considered biased, either under or over-estimated (Li, 2007; Chary, 1995); hence, further investigation is needed (Wisner et al., 2008). Ideally, the value of tracking signal is either zero or close to zero (Stevenson, 2005; Khanna, 2007). With these characteristics, tracking signal is, therefore, strongly suggested to achieve the objective stated previously. The control limits under the method are set as the following.

Under the Brown's method, with the assumption that the errors are normally distributed with a mean of 0 and a standard deviation of σ, the relationship between σ and MAD is given by $\sigma \approx 1.25MAD$ (Lawrence et al., 2009). As such, if the control limits for BTS are set at ±3.75 which is equivalent to $\pm 3\sigma$, the probability of an out-of-control signal is only 0.27% (Montgomery, 2009). Practically, the value of the control limits ranges from ±4 to ±8 be considered acceptable in some particular circumstances (Li, 2007; Wisner et al., 2008).

This approach can be employed in various applications. As an example, in this paper, it is used to evaluate the accuracy of the time estimator in a project.

EMPIRICAL STUDY

In our study, we followed a specific project at a well-known company which specializes in manufacturing electronic devices in Kaohsiung industrial park, Taiwan. Its research and development (R&D) department is in charge of not only improving the performance of its current products but also searching for, designing and testing new products. Because several functions of an organization concurrently are obligated with the planning and implementation of research and development projects and basic scientific researches as well as the execution of the clients-commissioned technical services responsible for internal and external customers, the majority of the members are in charge of a different proportion of research and development projects, basic scientific researches and technical service tasks. There is only one leader who assigns the in-charge person with time estimation for each task. He is called time estimator. Due to the fact that R&D department is in charge of various activities, whose execution time can be as short as a few hours or as long as up to three months or more, the time estimator sometimes has some errors in his estimation. In order to improve his capability and working experience in the time estimation, it is quite important to track the accuracy of his estimation. Therefore, we suggest using the tracking signals to detect any abnormal situation where his estimation is significantly different from the actual observation.

In the project, there were 20 critical tasks to be conducted within 240 hours. Each of the tasks was expected to be completed within "expected time" as shown in Table 1. However, due to the knowledge and skills of the engineers, some tasks were finished sooner but some were

later than expected. The actual completion time of each task is named as "observed time", also shown in Table 1. In this paper, for the ease of comparison the performance of the tracking signal under different α values, we consider it under the α values of 0.20, 0.25 and 0.30. The relevant values are plotted on a control chart with the control limits of ±3.75 as shown in figure 1.

Table 1. Tracking signals under different α values

Task No.	Expected time *(hours)*	Observed time *(hours)*	ε	CFE	α = 0.20		α = 0.25		α = 0.30	
					SMAD	BTS	SMAD	BTS	SMAD	BTS
1	4	4	0	0	0.00		0.00		0.00	
2	11	10	1	1	0.20	5.00	0.25	4.00	0.30	3.33
3	7	10	-3	-2	0.76	-2.63	0.94	-2.13	1.11	-1.80
4	10	12	-2	-4	1.01	-3.97	1.20	-3.32	1.38	-2.90
5	4	6	-2	-6	1.21	-4.97	1.40	-4.28	1.56	-3.84
6	9	6	3	-3	1.57	-1.92	1.80	-1.67	1.99	-1.50
7	18	18	0	-3	1.25	-2.40	1.35	-2.22	1.40	-2.15
8	26	23	3	0	1.60	0.00	1.76	0.00	1.88	0.00
9	8	12	-4	-4	2.08	-1.92	2.32	-1.72	2.51	-1.59
10	14	12	2	-2	2.07	-0.97	2.24	-0.89	2.36	-0.85
11	20	16	4	2	2.45	0.82	2.68	0.75	2.85	0.70
12	12	14	-2	0	2.36	0.00	2.51	0.00	2.60	0.00
13	5	10	-5	-5	2.89	-1.73	3.13	-1.60	3.32	-1.51
14	15	18	-3	-8	2.91	-2.75	3.10	-2.58	3.22	-2.48
15	12	10	2	-6	2.73	-2.20	2.82	-2.12	2.86	-2.10
16	8	10	-2	-8	2.58	-3.10	2.62	-3.05	2.60	-3.08
17	20	22	-2	-10	2.47	-4.05	2.46	-4.06	2.42	-4.13
18	15	14	1	-9	2.17	-4.14	2.10	-4.29	1.99	-4.51
19	10	8	2	-7	2.14	-3.27	2.07	-3.38	2.00	-3.51
20	12	5	7	0	3.11	0.00	3.31	0.00	3.50	0.00
Total	240	240								

Based on the tracking signals in Table 1 and Figure 1, there are five, four and three out-of-control points detected, respectively to the α values of 0.20, 0.25 and 0.30. Although the total project time was strictly met, the estimation was not really good enough. The estimator should pay more attention to the characteristics of each task and assign appropriate engineers to perform the task efficiently. Furthermore, it is easily found that the smaller value of α, the smoother the tracking curve and the more out-of-control signals. Hence, it is suggested that if the estimator is qualified as really experienced, we should set the α value small so that it can give more tolerance of the abnormal estimation; whereas, larger α value is more suitable for senior estimator.

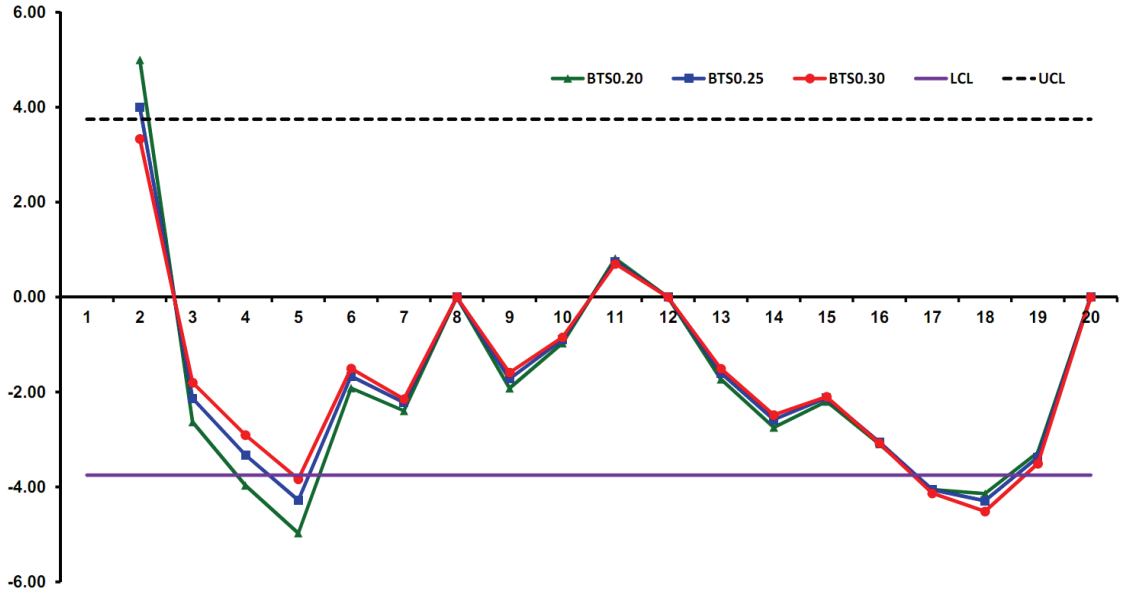


Figure 1. Tracking signals under α values 0.20, 0.25 and 0.30

CONCLUSION

Keep track on the time performance of employees in a project is critical because any out-of-control issue will affect the whole timeline of the project. There are some circumstances where the employees already try their best but they still can't meet the time target and there are other ones where they can easily achieve the set goal. These happen because of the inaccuracy of the time estimation and personnel assignation given by an estimator and/or his/her shortage in well knowing the actual capability of the employees. In order to evaluate the effectiveness and accuracy of the estimator in performing his job, it is suggested that we should keep monitoring the time estimation of critical tasks by using tracking signal method. In this paper, with a practical example, it is found that although the total time of a project is well estimated and met, the quality of the time estimation is still not good enough. Therefore, the estimator must take special attention to assign more realistic time and more appropriate personnel in the critical tasks that were detected out-of-control. By this way, he/she can perform his/her job better and get to know the employees better and better.

REFERENCE

1. Brown, R.G. (1959), Statistical forecasting for inventory control, McGraw-Hill, New York.
2. Chary, S.N. (1995), Theory and Problems in production operation management, Tatt McGraw-Hill Education, New Delhi.
3. Gardner, E.S. (1985), "Exponential smoothing: State of the art", Journal of Forecasting, Vol. 4, pp. 1-28.
4. Khanna (2007), Production and Operations Management, PHI Learning, New Delhi.
5. Lawrence, K.D., Klimberge, R.K. and Lawrence, S.M. (2009), Fundamentals of forecasting using excel, Industrial Press, New York.
6. Li, L. (2007), Supply chain management: Concepts, Techniques and practices, World Scientific, Singapore.

7. Li, Y., Lange, M. and Stocks, C. (2012), "Monitoring forecasting systems- Revisit Trigg's tracking signal", paper presented at the 32nd Annual International Symposium on Forecasting (ISF2012), Boston, USA, available at: http://www.forecasters.org/proceedings12/LiYikangISF2012.pdf (accessed 25 January, 2013).
8. Mele, M., Secchiari, P., Serra, A., Ferruzzi, G., Paoletti, F. and Biagioni, M. (2001), "Application of the 'tracking signal' method to monitoring of udder health and oestrus in dairy cows", Livestock Production Science, Vol. 72, pp. 279-284.
9. Montgomery, D.C. (2009), Introduction to Statistical Quality Control, Wiley, Asia.
10. Page, E.S. (1995), "A test for change in a parameter occurring at an unknown point", Biometrica, Vol. 42, pp. 523-527.
11. Snyder, R.D. and Koehler, A.B. (2006), "Incorporating a tracking signal into state space models for exponential smoothing", working paper 16/06, Monash University, Australia.
12. Spinner, M.P. (1992), Elements of Project management: Plan, Schedule and Control, Prentice-Hall, New Jersey.
13. Spinner, M.P. (1997), Project Management: Principles and Practices, Prentice-Hall, New Jersey.
14. Stevenson, W.J. (2005), Operations management, McGraw-Hill/Irwin, New York.
15. Wallace, T.F. and Stahl, R.A. (2002), Sales forecasting: A new approach, T.F. Wallace & Co, Ohio.
16. Wisner, J.D., Tan, K.C. and Leong, G.K. (2008), Principles of supply chain management: A balanced approach, Cengage Learning, Ohio.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

TIME-DEPENDENT VEHICLE ROUTING PROBLEM IN BANGKOK

Warinda Kiatdherarat, Department of Electrical and Software Systems Engineering
The Sirindhorn International Thai-German Graduate School of Engineering (TGGS)
King Mongkut's University of Technology North Bangkok
kamoll@kmutnb.ac.th

Pathai Suwannawiwat, Department of Electrical and Software Systems Engineering
The Sirindhorn International Thai-German Graduate School of Engineering (TGGS)
King Mongkut's University of Technology North Bangkok
kamoll@kmutnb.ac.th

Kamol Limtanyakul, Department of Electrical and Software Systems Engineering
The Sirindhorn International Thai-German Graduate School of Engineering (TGGS)
King Mongkut's University of Technology North Bangkok
kamoll@kmutnb.ac.th

Abstract

We suggest a scheme to solve a time dependent vehicle routing problem in Bangkok. In fleet transportation, we usually prefer routes aiming to minimize the number of vehicles and the total distance. However, traffic congestion has significant impact on cost and time for transportation. As traffic information in Bangkok is provided real-time in the internet, we can collect congestion levels of roads and estimate travelling times of vehicles. Based on time-dependent shortest paths between locations, we determine a route of each vehicle to minimize the total travel time, while all vehicles depart from a depot together.

Our preliminary result based on the sampled data is further presented. The change of traffic situation causes ineffectiveness of routes based only on minimizing the total distance. Solving the routing problem using the traffic information can help reduce the total travel time. This study could be further applied to verify and improve the performance of logistic process.

Keyword: Vehicle Routing, Time dependent, Traffic, Logistics, Optimization

INTRODUCTION

We study a time-dependent vehicle routing problem in Bangkok based on available traffic information. In a standard routing problem, we aim to minimize a number of required trucks and the total distance to travel from a distribution center to customers. Nuangrit (2007) studied the case for convenient stores in Thailand and suggested his solving algorithms. He also mentioned a limitation as the travel time can be simply calculated by the constant speed limits of roads.

In fact, traffic congestion significantly varies during a whole day in a big city like Bangkok and has an impact on the actual travel time and the delay of vehicles. Therefore, the time-dependent vehicle routing problem should be studied. Although the real traffic situation can

be different from the available information used for planning, the result could help us obtain a routing schedule which is more realistic for time and resource management.

Nowadays, traffic information becomes widely accessible in the internet. In Bangkok, there are several providers e.g. Intelligent Traffic Information Center (www.iticfoundation.org), Traffy(www.traffy.in.th), TSquare Traffic (https://app.rtic-thai.info/tsquare), Longdo Traffic (http://traffic.longdo.com). These systems collect and present information from various sources like probing data from buses, taxis, fleets and passenger cars. In addition, they present congestion levels of roads obtained from Bangkok Metropolitan Administration (http://www.bkktraffic.com).

Moreover, Traffy is a research project to estimate and report traffic information under National Electronics and Computer Technology Center (NECTEC). First, Traffy system collects data from similar sources as mentioned. Also, the system gets accident reports from traffic police and images from CCTV located around Bangkok. After data processing, traffic information is reported on social media like Twitter and Facebook. Programmers can further develop an application using Traffy API (Application Program Interface). Its output files consist of XML, HTML, JSON, CSV and JS.

In this paper, we apply Traffy API to store samples of traffic information in our database. Congestion levels on roads are used to estimate the speed of a vehicle and a travel time. Afterward, we solve a time-dependent shortest path problem as traffic changes from time to time. That means we determine a path using minimal time to travel between any two points. This path can change depending on a departure time. For example, we could prefer another path to avoid congestion during rush hours.

After that, we solve a vehicle routing problem (VRP) to find out customer visits of each vehicle with respect to capacity constraint. We assume a sample of the location of convenient stores in the urban area. There are several advanced techniques for solving a large scale vehicle routing problem. In this preliminary research, we apply a software tool named Drools Planner version 5.5 to solve our small cases. Note that the software has been recently renamed to OptaPlanner (www.optaplanner.org). We assume all vehicles departing from a distribution center at the same initial time. We focus on minimizing the total travel time for all vehicles based on the obtained time-dependent shortest paths between customers. We have not yet considered a departure time of each vehicle as another decision variable. Otherwise, we could select the most suitable initial time for each vehicle depending on traffic situation.
Section 2 reviews algorithms or methods to solve both time-dependent shortest paths and vehicle routing problems. The methods using in this paper are discussed in Section 3. Computational results are shown in Section 4 before ending with conclusion.

LITERATURE SURVEY

In this section, we show some research articles related to solving a time-dependent shortest path and a time-dependent vehicle routing problem (TDVRP). In a map containing all roads and intersections, we need first to determine a shortest path from one point to another. We mainly have to calculate the shortest paths between a distribution center and all customers.

Dean (2004) studied a property of this problem and summarized several shortest path algorithms for a time-dependent network in both continuous and discrete time cases. Dehne and Omran (2012) focused on two types of the time-dependent FIFO network, the availability of the links with their change over time and the cost of using the link. Moreover, Liang Zhao et al. (2011) presented a novel generalized A* algorithm and an ALT algorithm using an appropriate estimator to reduce computation time. Their methods are more suitable especially for a large network than a normal Dijikstra algorithm.

The vehicle routing problem consists of a number of vehicles with its own capacity. There are customer demands to be supplied by a distribution center. We need to find a route representing customers that each vehicle has to visit. The problem aims to minimize a number of vehicles and total distance, while the capacity constraint must be satisfied.

Kumar and Panneerselvam (2012) presented a survey on the vehicle routing problem and its variants. They introduced several algorithms based on exact methods, heuristic approaches, meta-heuristic, and hybrid method. Their study showed that only few researchers use hybrid methods to solve a vehicle routing problem due to the time needed to find the optimal solution will be prohibitive. Rousseau and Gendreau (2002) applied the operator for searching on large neighborhood. They used the pruning and propagation techniques of constraint programming to achieve more efficient search.

As the time-dependent vehicle routing problem is NP-Hard as a generalization of the travelling salesman problem which, several solving methods and heuristics are developed. For example, Potvin et al. (2004) introduced an algorithm to calculate the travel time. Figliozzi (2009) suggested how to construct a route and re-route according to the traffic congestion. Balserio et al. (2011) applied Ant Colony Optimization. Moreover, Kim and Jeon (2010) introduced Genetic Algorithm and Mathematical Programming for make decision with the traffic congestion.

METHODOLOGY

We describe here three main procedures applied to solve our problem. First, traffic information from Traffy has to be estimated in order to calculate a travel time. Then, we select the Dijikstra algorithm modified for finding a shortest path in a time-dependent network. Finally, our method to solve the TDVRP is briefly discussed. In this preliminary step, simple algorithms used in this paper are not yet appropriate for solving very large scale cases.

1. Processing traffic information from Traffy

Traffy API allows us to check traffic status by executing a command Get Traffic Congestion. This API returns three levels of Traffic congestion which consist of high, medium and low. The website of Intelligent Traffic Information Center (www.iticfoundation.org/node/41) suggests a possible range of velocity for roads in a city: High status represents a speed lower than 15 km/hr, Medium status represents a speed between 15-25 km/hr, Low status represents a speed more than 25 km/hr.

To determine a travel time from these congestion levels, we need to assume that the High, Medium, and Low status equivalent to 15 km/hr, 25 km/hr, and 60 km/hr, respectively. Each location in a map is represented by its latitude and longitude. Thus, a distance between two nodes is approximately determined by using the Eucladian norm. Thus, a travel time depends on the distances and congestion levels of roads needed to travel along.

2. Solving Time-dependent Shortest Path

To determine a shortest path from a source node to a destination node, Dijikstra's algorithm is one of standard algorithms. Its computation based on constant values of distances between nodes. However, in a time-dependent network we need to consider a travel time which varies according to current values of congestion levels. Thus, the travel time for each time interval can be different.

Figure 1 shows a modified Dijkstra's alogrihm given by Dean (2004). This algorithm determines $EA_{si}(t)$ which is a shortest path from a source node s to any destination node i, when leaving from the source node at time t. At the beginning, $EA_{si}(t)$ is initialized with a large value. The search explores from the start node to all nodes in neighborhood. To maintain a minimal value, the algorithm finds out whether there exists a better path visiting other node j before going to node i, $a_{ij}(EA_{si}(t))$. Note that this algorithm might not be efficient enough for solving a large network.

Initialization
  For all i ϵ N\{s}: $EA_{si}(t) \leftarrow \infty$
  $EA_{ss}(t) \leftarrow t$
  S $\leftarrow N$
Main Loop
  While S $\neq \emptyset$
    Select i ϵ S minimizing EA_{si}(t)
    S $\leftarrow S\backslash\{i\}$
    For all j such that (i,j) ϵ A
      $EA_{si}(t) \leftarrow \min \{EA_{si}(t), a_{ij}(EA_{si}(t))\}$

Figure 1: Dijikstra's algorithm for solving time-dependent shortest path

3. Solving Time-dependent Vehicle Routing Problem

Drools Planner is a library platform written in Java to solve planning and scheduling problems. It has several internal heuristics and metaheuristics based on score calculation. Many examples are included, e.g. vehicle routing problem, nurse scheduling, bin packing. We further modify its VRP example to calculate a departure time of each node and use a time dependent shortest path for optimization process. Available optimization techniques are applied.

First, a construction heuristic builds a pretty good initial solution in a finite length of time. This initial solution may not be feasible but can help metaheuristics to finish the solving process. In our case, the First Fit Decreasing is applied to allocate the most difficult planning entity/variable first since it is critical to fit in our limited resource. Other remaining entities have less degree of difficulty and could be allocated later.

Afterward, local search starts searching from the initial solution to find out a better one. A number of moves for each solution are evaluated before the best move is applied. The program searches until reaching termination criteria like timeout. Tabu list is also used to improve the hill climbing process and avoid the search getting stuck in local optima.

COMPUTATION RESULTS

The traffic network obtained from Traffy consists of 450 nodes. Figure 2 shows the locations of these nodes and the connected links in red color, while actual roads are in yellow color. We notice that the links obtained from Traffy are not completely connected like a real road network. On some roads traffic information are still missing. Thus, we have to create additional links and assume that the congestion levels of these links are always low.

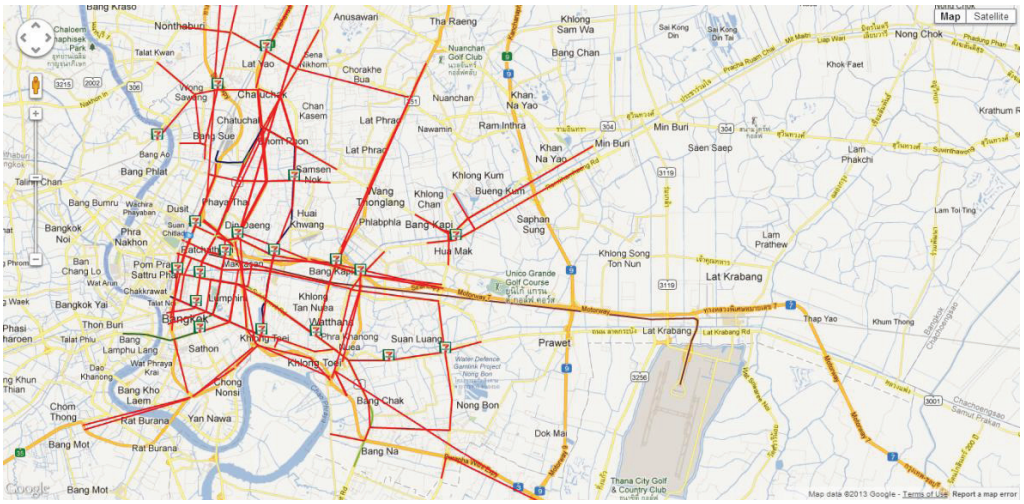


Figure 2 – Available Traffic Information on Links highlighted by Red Color

Moreover, we select 19 nodes around the city center to represent locations of convenient stores. As our primary objective is to minimize a number of required vehicles, we found that three trucks are needed to support the total demand of all stores. The sample data used in our experiment was taken every 30 minutes on Monday, March 11, 2013 between 5.00-9.00 a.m. We assume congestion levels do not change during the 30-min interval.

Table 1 compares two solutions finding routes with the minimum total travel distance and the minimum total travel time. In the first case, we achieve an optimal solution based on the selection of paths using only a shortest distance. The second case applies traffic information to select a path with a shortest travel time. In both cases, all vehicles have to leave from a distribution center at the same initial time. Drools planner and Dijkstra's algorithm need together around 5 minutes to achieve the solutions.

Table 1 – Comparison of Solutions: Minimizing Total Distance and Minimizing Total Time

Vehicle	Route Minimizing Total Distance		Route Minimizing Total Time	
	Total Distance (km)	Total Time (min)	Total Distance (km)	Total Time (min)
1	41	199	64	225
2	71	198	121	383
3	43	338	32	106
Sum	196	735	217	714

The route with minimizing total time clearly requires less travel time, while its total travel distance becomes larger. However, the difference is not so much because we assume low congestion levels for additional links created to fulfill missing traffic information. The program can always avoid roads with traffic congestion. Also, our primary objective limits us to always use three vehicles for both cases. The vehicles still have to significantly travel across the city.

We can notice also that it is better to estimate the travel time of each vehicle by using traffic information. When the constant speed of 60 km/hr is assumed for all links, the obtained travel time becomes significantly different from the reality. For example, we cannot expect the vehicle 1 spends just 41 minutes to cover its travel distance of 41 km. The traffic information can help predict when each truck can come back to depot and become available for next delivery.

CONCLUSION

Our research solves a vehicle routing problem based on real traffic information. We suggest a scheme to collect and interpret congestion levels from the available resource in the internet. The Dijkstra's algorithm is applied to determine a time-dependent shortest path. In this work, we still assume that all vehicles have to leave a depot at the same time, while a fastest path is selected depending on a current arrival time of each node. Drools planner further solves a vehicle routing problem to minimize the total travel time.

The computation results verify that it could be more efficient to apply a route using less travel time. Although vehicles have to travel longer distance, they can return to a distribution center earlier and can be reused for other deliveries. That means we can reduce the size and fix cost to operate the fleet.

The impact of wasting time could be higher when the number of store increases and transportation during the peak rush hour is inevitable. However, the cover areas, reliability and accuracy of traffic information are still main limitations and have to be evaluated more in practice.

In the near future, the quality of information could be further improved by the service providers since there are more vehicles sharing their location signals to traffic centers via smart phones and a modern mobile network. In addition, our methods to solve a time-dependent shortest path and a time-dependent routing problem have to be improved to achieve better solutions especially for a large network.

ACKNOWLEDGEMENT

The work is supported by a grant from Science and Technology Research Institute, King Mongkut's University of Technology North Bangkok.

REFERENCES

1. Balseiro, SR, Loiseau, I & Ramonet, J 2011, 'An Ant Colony algorithm hybridized with insertion heuristics for the Time-dependent Vehicle Routing Problem with Time Windows'.
2. Dean, B 2004, 'Shortest Paths in FIFO Time-Dependent Networks: Theory and Algorithms', Technical Report, MIT, Cambridge.
3. Dehne, F & Omran, M 2012, 'Shortest Paths in Time-Dependent FIFO Networks', Algorithmica, vol 62, pp. 416-435.
4. Figliozzi, MA 2009, 'A Route Improvement Algorithm for the Vehicle Routing Problem with Time-dependent Travel Times', the 88th Transportation Research Board Annual Meeting.
5. Fleischmann, B, Gnutzmann, S & Sandvoß, E 2004, 'Dynamic Vehicle Routing Based on Online Traffic Information', TRANSPORTATION SCIENCE, vol 38, no. 4, pp. 420-433.
6. Kim, TK & Jeon, G 2010, 'A vehicle routing problem considering traffic situation with time windows by using hybrid genetic algorithm', 40th International Conference on Computers & Industrial Engineering (CIE-40), pp. 1-6.
7. Kumar, S & Panneerselvan, R 2012, 'A Survey on the vehicle routing problem and its variants', Intelligent Information Management, vol 4, pp. 66-74.
8. Nuangrit, A 2007, 'An application of computer programs for the routing of convenience store deliveries', Master Thesis (in Thai), Chulalongkorn University.
9. Roussean, L & Gendreau, M 2002, 'Using Constraint-based operators to solve the vehicle routing problem with time windows', Journal Heuristics, pp. 43-58.
10. Zhao, L, Oshima, T & Nagamochi, H 2011, 'Algorithm for time-dependent shortest path problem', in Computational Geometry, Graphs and Applications, Springer Berlin Heidelberg.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

A SYSTEM DYNAMICS MODEL OF TRUST, KNOWLEDGE SHARING AND STABILITY OF STRATEGIC ALLIANCE

Chinho Lin, Institute of Information Management of National Cheng Kung University, Taiwan R.O.C,
Email: linn@mail.ncku.edu.tw

NguyenDong-Thai Dao, Department of Industrial and Information Management of National Cheng Kung University, Taiwan, R.O.C.,
Email: thaipr.action@gmail.com

ABSTRACT

Purpose: *We present a comprehensive framework of the key determinants of the stability in strategic alliances (SAS). Herein the relationship of triad: trust, knowledge sharing and stability is digged dramatically.*
Design/ methodology/approach: *We propose a dynamics framework of stability in SAS based on a review of the literature. The game theory concept is adopted in the conceptual framework. The simulation is based on the system dynamics and characterizes how the constituent elements of the strategic alliance behave.*
Findings: *The major finding of this paper is that result from the literary verbal analysis can be transferred into a dynamics model which can be used to fulfill determinants of the stability of strategic alliance.*
Practical implications: *Based on the framework, a number of propositions are developed to facilitate empirical research on trust, knowledge sharing and stability in SAS. Managerial implications from the framework are also discussed.*
Originality/ value: *The value of this paper is literary verbal analysis can be transferred into a dynamics model which can be used to fulfill determinants of the stability of the strategic alliance. We find out that in case of low trust and high level of the un-balance knowledge sharing the strategic alliance became extremely unstable and vise versa.*

INTRODUCTION

Among the various factors impinging upon making a decision in an uncertain environment, fear and trust are surely crucial ones. Several models for trust have been proposed in the literature preview. Trust, defined as one party is confident that the other party in the exchange relationship will not exploit its vulnerabilities, become a potential variable in research on inter-organizational relationships. Scholars draw on theoretical concepts such as transaction costs, relational governance, and transaction value (McEvily and Zaheer, 2006) just only to explain the positive effects of trust on the success of strategic alliances.

Knowledge, unlike to traditional production-related factors such as labor, capital, and land, has become the key element in the development of enterprises (Gravier et al., 2008) . At the same time, technology innovation is often implemented on a large scale, and involves large systems and socialized cooperation, which means companies will have to stand high costs; the limited

resources of a single enterprise prevent it from satisfying the demands of technological innovation (Ruckman, 2009). The technology innovation alliance (Jiang et al., 2008b) is considered as the main driver of enterprise cooperation in the knowledge economy era. Because of it not only enables access to capital, technology, talent, and information on technology innovation, but also enables new knowledge transfer and the acquisition of complementary resources by effectively using and reintegrating the superior resources of member firms (Butler, 2008, Dussauge et al., 2004) state that given the strategic alliance's inherent properties. Alliance instability is caused by the unplanned alteration of goals, contracts, and control modes in the allied process, as well as by disintegration and mergers (Inkpen and Beamish, 1997). It may also pertain to significant conducts, such as alterations in strategic direction, agreement renegotiation, ownership or governance construction, and changes in cooperative relationship, that influence alliance performance (Yan and Zeng, 1999). The contradictory evolutions of cooperation and competition, structural rigidity and strategic flexibility, as well as short-and long-term goals lead to instability in alliance operations and management(Das and Teng, 2000a, Ernst and Bamford, 2005). Contractual relationships, mutual trust, organizational learning, benefit distribution, and cultural differences also significantly affect alliance stability (Gil and Passino, 2006, Jiang et al., 2008a). To maintain competitive advantage sustainably, firms must embrace knowledge sharing and learning, for which the Strategic Alliance has provided a good opportunity.

We suggest that the possibility of an influence of trust needs to be investigated to clarify our understanding of the role of trust in stability of strategic alliances (SAS) and the associated recommendations with regard to the development of knowledge sharing in SAS under system dynamic perspective. This research is based on a game theory principle (Das and Kumar, 2009) and characterizes the maintenance of strategic alliance

Therefore, this paper may contribute significantly to the field as it develops a dynamic game theoretic model to analyze the interaction of knowledge sharing and trust has on the stability of strategic alliance and characterizes how the constituent elements of the strategic alliance behave. The value of this paper lies in the transformation of verbal model into a quantified simulation model and we learn result from the simulation.

LITERATURE REVIEW

1. Knowledge sharing and trust

Based on the resource-based view (RBV), knowledge sharing and competitive advantage are the competence of a strategic alliance. Heterogeneity and immobility are at the heart of the RBV. For example, the RBV suggests that an industry may be heterogeneous in terms of the resources they control and these resources are imperfectly mobile across firms (Barney, 2001). This essentially suggests that resources are valuable in and of themselves, driving the choice of strategy and that competitive advantage is derived through a combination of unique organizational resources in obtaining virtual monopoly positions in their respective markets (Prahalad and Hamel, 1994). (Das and Teng, 2000b) suggest that the RBV has rarely been applied in examining strategic alliances. They argue that the RBV provides an appropriate

framework for examining alliances as essentially they are formed to gain access to other fir m's valuable resources.

According to (McGee, 2012), alliances enable partners to gain access to each other's resources temporarily and with more flexibility than mergers and acquisitions. The two related but distinct motives for a firm to consider forming a strategic alliance are to obtain resources of others and to retain and develop its own resources by combining them with others' resources. Resources are sometimes classified as property-based resources, which have clear property rights and in which a firm's ownership is absolute and protected by law, and knowledge-based resources, which cover tacit skills and knowledge involved in technological, managerial, and organizational resources. In this paper, we mention to the knowledge-based resources – knowledge sharing effected by the trust in SAS.

The intensification of resource sharing and inter-partner learning within strategic alliances makes trust between alliance partners even more crucial which is why inter-party trust plays an important role within successful strategic alliances (Luo, 2002). The rationale is that when alliance partners have high levels of trust in each other, they will be more likely to be committed to, and persist with, knowledge sharing.

2. Structural Cooperation and Motivational Cooperation

One source of instability in a strategic alliance arises because a partner relationship necessarily involves a situation analogous to the "prisoner's dilemma". In the "prisoner's dilemma" involving a cooperative relationship, betrayal or deviation yields a greater payoff than does cooperation for each firm; therefore, both firms choose betrayal and, as a result, the payoff for each is low. Two conceivable ways of maintaining a strategic alliance exist, namely, the "structural cooperation approach" and the "motivational cooperation approach" (Zeng and Chen, 2003).

The "structural cooperation approach" attempts to resolve the dilemma by changing the payoff structure of the game. Put simply, "changing the payoff structure" means applying some penalty to a player who chooses to deviate. Adding a penalty provides an incentive to choose cooperation. In this sense, such methods attempt to maintain a cooperative relationship through the adoption of a penalty system. For this reason, we call methods that change the payoff structure "structural cooperation." Thus, structural cooperation becomes effective when partners behave opportunistically.

The "motivational cooperation approach" attempts to resolve the dilemma intrinsically, or voluntarily, without using any structural means. Motivational cooperation becomes effective when the game is repeated infinitely, as well as when the expected payoff is sufficiently high. First, in a finitely repeated game, betrayal is optimal for each player, even if the game is played a thousand times. Even if a cooperative relationship continues until the 999-th trial, betrayal is preferred by each player in the final trial, because there is no need to consider the future. Since it is known that deviation will occur in the final trial, the best strategy is deviation from the beginning to the end, whenever the number

of trials is finite. Therefore, in the finitely repeated case, both players choose to deviate, and no cooperative relationship arises. However, in the infinitely repeated case, it is beneficial for both sides to select a cooperative strategy if certain conditions are fulfilled. This fact is generally known as the "Folk Theorem"(Arend and Seale, 2005). The Folk Theorem also makes clear that, if the expected future payoff is sufficiently high, it is more advantageous to select a cooperative strategy than to deviate via betrayal.

That is, even if penalties for betrayal are adopted as an institution, there is no guarantee that all parties to the alliance will comply with it. Rather, it becomes necessary to monitor compliance and to put the penalty system into effect in the case of noncompliance. These activities naturally require some expense. Moreover, if the expense resulting from the implementation of the penalty system exceeds the amount of the additional gain generated by cooperation, it becomes meaningless to create such a system and impose regulations such as monitoring and penalty enforcement. In practice, it is not possible to monitor a business partner accurately. Therefore, it is difficult to maintain a cooperative relationship through structural cooperation.

3. Trust and stability of Alliance

Numerous studies have acknowledged that trust formation is crucial for maintaining strategic alliances. For example, Child and Faulkner (1998) have pointed out that trust is crucial for the success of alliances (joint ventures). The others has clarified empirically that trust between joint-venture partners is crucial for the maintenance of long-term relationships.

"Trust" is defined as "the expectation that the other party will behave cooperatively towards one's self in a situation where there is potential for one's self to suffer losses if the other party behaves selfishly (Das and Teng, 2001b). Deterrence-based trust occurs when a partner is trusted because he will incur a large loss in the case of betrayal. Calculus-based trust occurs when a partner is trusted because he expects to receive a large benefit in the future as a result of his cooperation. In the contexts of these two types of trust, it is difficult to calculate the changes in the gains or losses that occur as uncertainty increases; thus, these concepts differ from a concept of "trust" whereby the partners cooperate, even if they find themselves in an uncertain situation.

4. System Dynamics

System dynamics is a technique for simulating the behavior of complex social systems and was originally an application of automatic control theory (adopted from engineering fields) to issues in the social sciences. Under system dynamics, the simulation of system behavior is carried out in order to elucidate a certain phenomenon in a complex social system; this task is accomplished by using a simplified system created by selecting the things thought to be key factors driving the phenomenon, and by clarifying the causal relationship of these factors. We develop the SD model of an arbitrary job-shop consisting of eight workstations (m = 8) of products. In SD discipline, the model is usually presented as a

stock-flow diagram that captures the model structure and the interrelationships among the variables (Sterman, 2000). The stock-flow diagram is translated into a system of differential equations, which is then solved via numerical simulation. The embedded mathematical equations are divided into stock equations (state equations), which integrate the net flow into a stock, and flow equations (rate equations), defining the inflows and outflows among the stocks as functions of time. Fig. 1 illustrates the generic stock-flow diagram. The SD model is developed using the Vensim software package.

One distinguishing feature of system dynamics is that it facilitates learning about dynamic systems that vary over time. Note that time discrepancies exist in the relationships among factors in real-world systems, as well as differences in the speed of effects. Another distinguishing feature is that system dynamics facilitates learning about complex systems that incorporate feedback. This feature is useful because the relationships among factors in real-world systems are typically not one way.

More technically, complex time-series systems are modeled using simultaneous difference equations or simultaneous ordinary differential equations, and problems are solved by supplying initial values for those equations.

CONCEPTUAL MODEL

The figure illustrates the causal relationship model of the triad: Unbalance in knowledge sharing; Stability in Strategic Alliance and Trust:

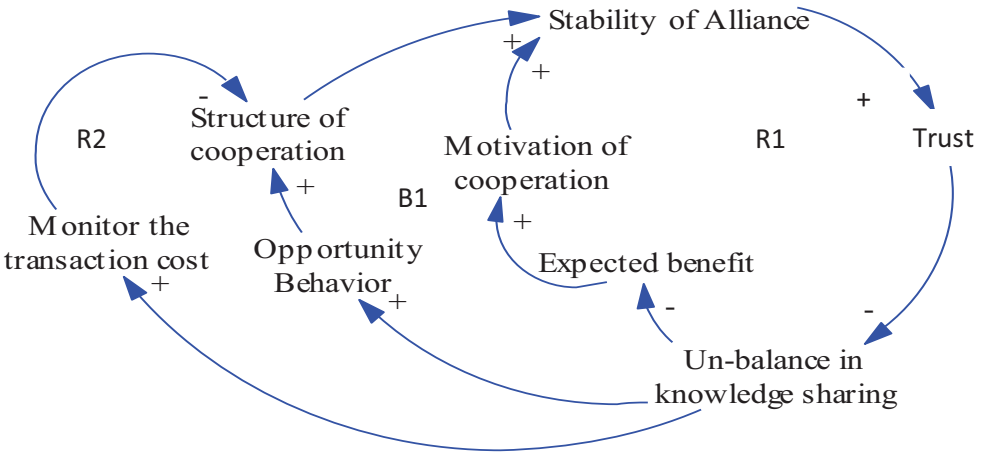


Fig. 1 Causal Relationship Model Concerning the Stability of Strategic Alliance

Figure 1 illustrates a causal relationship model of the factors that affect the stability of a strategic alliance. The model comprises three reinforcement loops (Rl, R2, B1).

Loop Rl

This reinforcement loop comprises un-balance in sharing knowledge, expected payoffs, motivation of cooperation, the stability of the strategic alliance and trust.

Trust in the workplace has been shown to have a strong and robust influence on a variety of organiza-tional phenomena, including job satisfaction, stress,organizational commitment, productivity, and, most relevant to the current research, knowledge sharing(Kramer, 1999, Levin and Cross, 2004). Therefore, if trust is high, then un-balance in sharing knowledge decreases. Outcome expectations that are related to reward systems (Bartol and Srivastava, 2002) are also important factors influencing the decision to share knowledge. According to the economic exchange theory, individuals will behave by rational self-interest, thus, knowledge sharing will occur when its outcomes exceed its costs or are as expected (Constant et al., 1994). This is why practitioners emphasize incentive systems for successful knowledge management., outcome expectations imply that, members of SAS believe that they would receive extrinsic benefits such as monetary rewards, promotion, or educa-tional opportunity from their knowledge sharing, then they would develop a more positive attitude toward knowledge sharing (Bock and Kim, 2002, Kankanhalli et al., 2005). On the other hand, un-balance in sharing knowledge decreases, the expected payoffs increase.

According to the equity theory of motivation, those who perceive themselves as being treated unfairly will be motivated to restore a sense of equity. Similarly, a partner firm, which foresees an inequitable pattern of payoffs, may expect itself or its partners to behave discordantly in the future(Das and Teng, 2001a). If one partner feels that the other partner gains too much from the alliance as compared to its own gain, it may begin to commit itself less, notwithstanding its own stake. As the expected payoffs increase, motivational cooperation increases. It leads to motivational cooperation increases, the stability of the strategic alliance increases. Therefore, the stability of the strategic alliance increases, trust will increases. As trust increases, un-balance in sharing knowledge decreases. Moreover, the stability of the strategic alliance is reinforced through the repetition of this cycle.

In contrast, as the previous research mentioned above we can propose the assumption as following: if trust is low, then un-balance in sharing knowledge increases. As un-balance in sharing knowledge rises, the expected payoffs decrease. As the expected payoffs decrease, motivational cooperation decreases. As motivational cooperation decreases, the stability of the strategic alliance increases. As the stability of the strategic alliance increases, trust decreases. As trust decreases, un-balance in knowledge sharing increases. In addition, the instability of the strategic alliance is reinforced through the repetition of this cycle.

Loop R2

This reinforcement loop comprises un-balance in sharing knowledge, the cost of transaction monitoring, structural cooperation, the stability of the strategic alliance, and trust.

Trust in the workplace has been shown to have a strong and robust influence on a variety of organiza-tional phenomena, including job satisfaction, stress,organizational commitment, productivity, and, most rel-evant to the current research, knowledge sharing(Kramer, 1999, Levin and Cross, 2004). Therefore, if trust is high, then un-balance in sharing knowledge decreases. Outcome expectations that are related to reward systems (Bartol and Srivastava, 2002) are also important factors influencing the decision to share knowledge. According to the economic exchange theory, individuals will behave by rational self-interest, thus, knowledge sharing will occur when its outcomes exceed its costs or are as expected (Constant et al., 1994, Jiang and Hao, 2011). As the monitoring transaction cost decreases, structural cooperation increases. As structural cooperation increases, the stability of the strategic alliance increases. As the stability of the strategic alliance increases, trust increases. As trust increases, un-balance in knowledge sharing decreases. The stability of the strategic alliance is reinforced through the repetition of this cycle.

Based on the above literature review, we describe the causaul loop as followed, if the trust is low, the un-balance in sharing knowledge increases. As un-balance in sharing knowledge increases, the monitoring cost increases. As the monitoring transaction cost increases, structural cooperation decreases. As structural cooperation decreases, the stability of the strategic alliance decreases. As the stability of the strategic alliance decreases, trust decreases. As trust decreases, unbalance in knowledge sharing increases. The instability of the strategic alliance is reinforced through the repetition of this cycle.

Loop B1

This balance loop comprises un-balance in sharing knowledge, opportunistic behavior, structural cooperation, the stability of the strategic alliance, and trust.

As suppoting by previous research, if trust is high, the un-balance in sharing knowledge decreases. As un-balance in sharing knowledge decreases, opportunistic behavior decreases. As opportunistic behavior decreases, structural cooperation decreases. As structural cooperation decreases, the stability of the strategic alliance decreases.

On the other hand, as the stability of the strategic alliance decreases, trust decreases. As trust decreases, the un-balance in sharing knowledge increases. As the un-balance in sharing knowledge increases, opportunistic behavior increases. As opportunistic behavior increases, structural cooperation increases. As structural cooperation increases, the stability of the strategic alliance increases. As the stability of the strategic alliance increases, trust increases. As trust increases, un-balance in sharing knowledge decreases. In this case, therefore, the stability status of the strategic alliance becomes unstable, sometimes increasing and sometimes decreasing, through the repetition of this cycle.

SIMULATION MODEL AND OPERATION

Figure 2 illustrates the simulation model using Vensim (software for simulating system dynamics). The adopted simulation model is qualitative, not quantitative. The numerical values

chosen are all fictitious. Building a more complex model incorporating delay effects or complementary variables lowers the explanatory power of the model. Therefore, the model used for this analysis is simple. The model comprises three features: stocks, flows, and connectors. A stock is a variable that accumulates value as time passes. A flow is a variable that causes a stock to increase or decrease as time passes. A connector indicates the causal direction between variables. There are eight stock variables in the model: the stability of the strategic alliance, motivational cooperation, structural cooperation, the expected payoffs, trust, un-balance in knowledge sharing, opportunistic behavior, and the monitoring cost. There are also eight flow variables in the model, which include the changes in motivational cooperation, structural cooperation, the expected payoffs, trust, environmental uncertainty, opportunistic behavior, and the monitoring cost.

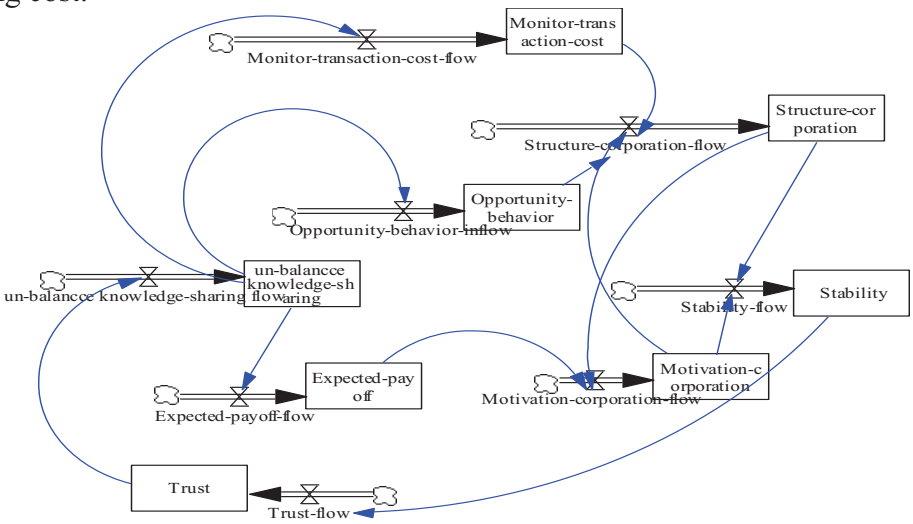


Fig. 2 Stock and flow structure of exploratory system dynamics model

Aas formulated, is that all the numerical values used are fictitious; this fact makes it more likely that the measured results will be large. To resolve this potential problem, it is necessary to prevent the numerical stock values from inflating by restricting all of the numerical flow values to fall within a certain constant range. Therefore, the original data are first transformed using a probit. Then, 0.5 is subtracted from them; this value ensures that all of the original data remain within the range from - 0.5 to 0.5. Thus, if an original datum is equal to zero, the transformed datum is still equal to zero. However, the greater the original datum is relative to zero, the closer the transformed datum comes to 0.5. Similarly, the smaller the original datum is relative to zero, the closer the transformed datum comes to - 0.5.

RESULT

The aim of the study was, primarily, to examine the relationship of triad: trust, knowledge sharing and stability of a strategic alliance. Besides, the motivation cooperation and on structure cooperation are observed how these impact changes over time. However, all of the data and coefficients are fictional; therefore, we established the following two patterns: (1) a high degree

of trust and low un-balance know sharing and (2) a low degree of trust and high un-balance knowledge sharing.

The initial values of the variables other than un-balance in knowledge sharing and trust are set to zero, which represent the state in which the respective variables are neither high nor low.

Scene 1: High trust, low level of the un-balance in knowledge sharing

We conduct this simulation by setting the initial value for trust at 10 and the initial value for un-balance in knowledge sharing at - 10. That the initial value for trust is 10.

Subsequent variations in the trust value indicate variation in trust. In addition, that the initial value for unbalance in knowledge sharing is - 10 indicates, that it is, in fact, close to 0.5; thus, unbalance in knowledge sharing is extremely low in this case.

Figure 3 illustrates the simulation results. First, only motivational cooperation (line 3) increases, while structural cooperation (line 2) decreases. This motion reflects the fact that a trade-off exists between motivational cooperation and structural cooperation. The stability of the alliance increases because the increase in motivational cooperation is greater than the decrease in structural cooperation. This result is in accord with the general prediction that cooperation tends to arise more easily in situations where trust between partners is high and the knowledge sharing is stable.

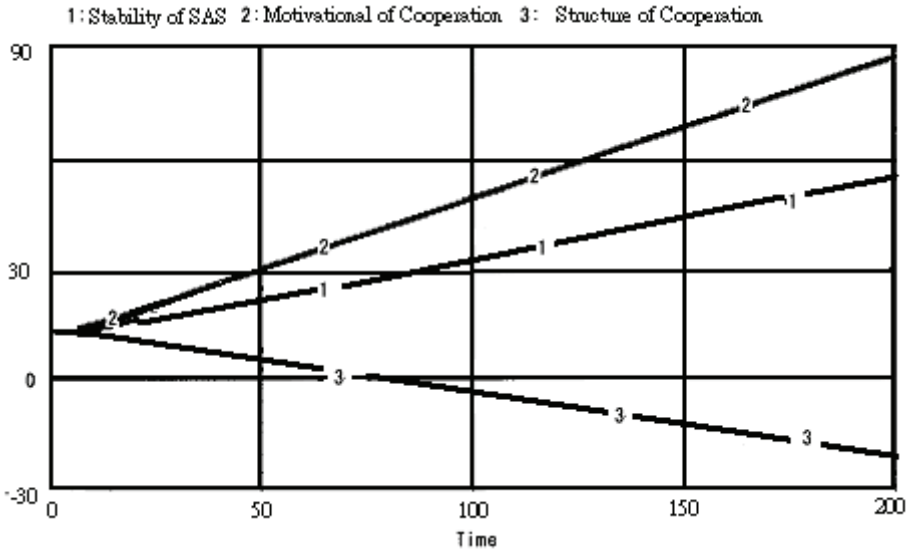


Fig. 3 Simulation result for stability of SAS with high trust, low level knowledge sharing

Scene 2: Low trust, high level of un-balance in knowledge sharing

We stimulate this simulation by setting the initial value for trust at - 10 and the initial value for level of un-balance of knowledge sharing at 10. That the initial value for trust is - 10 means, based on Formula 1, that it is, in fact, close to - 0.5; thus, trust is almost non-existent in this case.

In addition, that the initial value for un-balance of knowledge sharing is 10 indicates, that un-balance of knowledge sharing is extremely high. Figure 4 illustrates the simulation results. First, structural cooperation (line 2) increases about time 40, at which point it decreases. Then, after a time of about 170 has elapsed, it becomes negative. That is, after time 170, structural cooperation causes instability of the strategic alliance, rather than stability. On the other hand, motivational cooperation (line 3) decreases until about time 40, at which point it increases. After time 170, it becomes positive. That is, after time 170, the stabilization of the strategic alliance is promoted. However, the stability of the alliance always takes a negative value between time zero and time 210, and is itself extremely unstable. After time 210, it tends to increase with increases in motivational cooperation. In other words, if cooperation has not resolved by time 210, then the cooperative relationship thereafter becomes stable. This variation may occur in part because the maintenance of a long-term relationship leads to the formation of relational trust, a reduction in un-balance in knowledge sharing, and an increase in motivational cooperation.

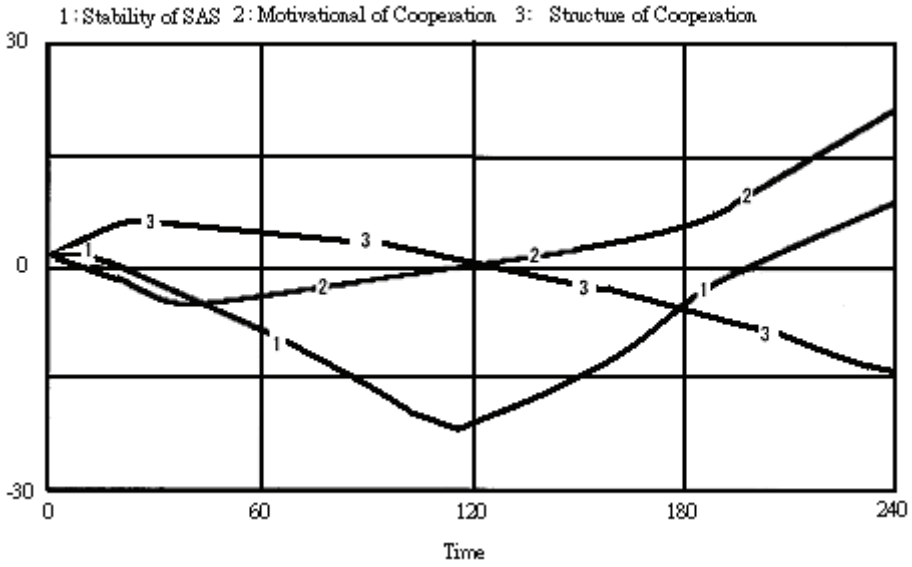


Fig. 4 Simulation result for stability of SAS with high trust, low level knowledge sharing

However, the stability of the alliance always takes a negative value between time zero and time 210, and is itself extremely unstable. After time 210, it tends to increase with increases in motivational cooperation. In other words, if cooperation has not resolved by time 210, then the cooperative relationship thereafter becomes stable. This variation may occur in part because the maintenance of a long-term relationship leads to the formation of relational trust, a reduction in un-balance knowledge sharing, and an increase in motivational cooperation.

CONCLUSION

In this paper, we have considered an analytic framework for the management of strategic alliances over the long term, and have conducted simulations using system dynamics. First, in this regard, we considered the implications of game theory, which provides a theoretical framework by which to examine the stability of the strategic alliance. Then, based on this

theoretical framework, we constructed an analytic model characterizing the stability of the strategic alliance. The key components of this model include motivational cooperation, structural cooperation, opportunistic behavior, a monitoring cost, expected payoffs, unbalance in knowledge sharing, and trust. We pointed out that these form a dynamic system involving feedback.

The major finding of this paper is that result from the literary verbal analysis can be transferred into a dynamics model which can used to fulfill determinants of the stability. We find out that in case of low trust and high level of the un-balance in knowledge sharing the strategic alliance became extremely unstable and vise versa. Based on this analytic model, we designed a simulation model using system dynamics. Assuming two scenes, namely high trust with low unbalance in knowledge sharing and low trust with high unbalance in knowledge sharing, we investigated how the stability of the strategic alliance, structural cooperation, and motivational cooperation behave over time. We found that stability with respect to a strategic alliance can be achieved through motivational cooperation in the case of high trust and low un-balance knowledge sharing. In the case of low trust and high un-balance knowledge sharing, we found that the strategic alliance became extremely unstable. Moreover, when a cooperative relationship is continued in this situation, despite the instability, the possibility exists that it will become stable due to the presence of motivational cooperation.

The contributions of this paper are presented as an analytic framework relating to the maintenance of a strategic alliance, a topic that has previously not attracted much attention. We have also demonstrated, based on the results of our simulations using system dynamics, that motivational cooperation is an effective means of maintaining the stability of the strategic alliance. The research also extend to some future works as following.

Firstable, the presented analytic model is not only a basic model, and more detailed variables should have been incorporated. For example, as trust formation factors, it would be useful in future research to consider partner reputation and the existence of past cooperative relationships.

Secondable, our simulations using system dynamics have been based only on fictitious numerical values. A highly practical simulation model could, in the future, be designed after the relationships between variables had been determined, based on a survey and a multivariate analysis of its results. Thirdly, we have not considered the issue of environment recognition. This paper has not incorporated the recognition patterns of companies themselves, which discriminate between environments, or the environmental uncertainty that exists within companies. With regard to the uncertainty of the external environment, it is conceivable that recognition scence differ across companies. In the future, these points too will need to be considered.

REFERENCE

1. AREND, R. J. & SEALE, D. A. 2005. Modeling alliance activity: an iterated prisoners' dilemma with exit option. Strategic Management Journal, 26, 1057-1074.
2. BARNEY, J. B. 2001. IS THE RESOURCE-BASED" VIEW" A USEFUL PERSPECTIVE FOR STRATEGIC MANAGEMENT RESEARCH? YES. Academy of management review, 26, 41-56.
3. BARTOL, K. M. & SRIVASTAVA, A. 2002. Encouraging knowledge sharing: The role of organizational reward systems. Journal of Leadership & Organizational Studies, 9, 64-76.
4. BOCK, G. W. & KIM, Y.-G. 2002. Breaking the myths of rewards: An exploratory study of attitudes about knowledge sharing. Information Resources Management Journal (IRMJ), 15, 14-21.
5. BUTLER, C. 2008. Problems in global strategic alliance management for European defence manufacturing firms. Management Decision, 46, 330-341.
6. CONSTANT, D., KIESLER, S. & SPROULL, L. 1994. What's mine is ours, or is it? A study of attitudes about information sharing. Information Systems Research, 5, 400-421.
7. DAS, T. K. & KUMAR, R. 2009. Interpartner harmony in strategic alliances: managing commitment and forbearance. Int. J. Strategic Business Alliances, Vol. 1, No. 1,.
8. DAS, T. K. & TENG, B.-S. 2001a. A risk perception model of alliance structuring. Journal of International Management, 7, 1-29.
9. DAS, T. K. & TENG, B.-S. 2001b. Trust, control, and risk in strategic alliances: An integrated framework. Organization studies, 22, 251-283.
10. DAS, T. K. & TENG, B. S. 2000a. Instabilities of strategic alliances: An internal tensions perspective. Organization Science, 11, 77-101.
11. DAS, T. K. & TENG, B. S. 2000b. A resource-based theory of strategic alliances. Journal of management, 26, 31-61.
12. DUSSAUGE, P., GARRETTE, B. & MITCHELL, W. 2004. Asymmetric performance: the market share impact of scale and link alliances in the global auto industry. Strategic management journal, 25, 701-711.
13. ERNST, D. & BAMFORD, J. 2005. Your alliances are too stable. Harvard Business Review, 83, 133-141.
14. GIL, A. E. & PASSINO, K. M. 2006. Stability analysis of network-based cooperative resource allocation strategies. Automatica, 42, 245-250.
15. GRAVIER, C., FAYOLLE, J., BAYARD, B., ATES, M. & LARDON, J. 2008. State of the art about remote laboratories paradigms-foundations of ongoing mutations. International Journal of Online Engineering, 4.
16. INKPEN, A. C. & BEAMISH, P. W. 1997. Knowledge, bargaining power, and the instability of international joint ventures. Academy of management review, 177-202.
17. JIANG, X., LI, Y. & GAO, S. 2008a. The stability of strategic alliances: Characteristics, factors and stages. Journal of International Management, 14, 173-189.
18. JIANG, Z.-S. & HAO, Y.-H. 2011. Game analysis of technology innovation alliance stability based on knowledge transfer. Computational & Mathematical Organization Theory, 1-19.
19. JIANG, Z., HU, L. & TIAN, Y. 2008b. Research on stability of industrial technology innovation alliance based on knowledge transfer value. Studies in Science of Science, S2.

20. KANKANHALLI, A., TAN, B. C. & WEI, K.-K. 2005. Contributing knowledge to electronic knowledge repositories: An empirical investigation. Mis Quarterly, 113-143.
21. KRAMER, R. M. 1999. Trust and distrust in organizations: Emerging perspectives, enduring questions. Annual review of psychology, 50, 569-598.
22. LEVIN, D. Z. & CROSS, R. 2004. The strength of weak ties you can trust: The mediating role of trust in effective knowledge transfer. Management science, 50, 1477-1490.
23. LUO, Y. 2002. Building trust in cross-cultural collaborations: toward a contingency perspective. Journal of management, 28, 669-694.
24. MCEVILY, B. & ZAHEER, A. 2006. 16 Does trust still matter? Research on the role of trust in inter-organizational exchange. Handbook of trust research, 280.
25. MCGEE, J. 2012. Just the FACTS101 E-Study Guide For: The Blackwell Encyclopedia of Management: Strategic Management, Cram101.
26. PRAHALAD, C. K. & HAMEL, G. 1994. Competing for the Future. Harvard Business Review, 72, 122-128.
27. RUCKMAN, K. 2009. Technology sourcing acquisitions: What they mean for innovation potential. Journal of Strategy and Management, 2, 56-75.
28. YAN, A. & ZENG, M. 1999. International joint venture instability: A critique of previous research, a reconceptualization, and directions for future research. Journal of International Business Studies, 397-414.
29. ZENG, M. & CHEN, X.-P. 2003. Achieving Cooperation In Multiparty Alliances: A Social Dilemma Approach To Partnership Management. Academy of Management Review, 28, 587-605.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

INTEGRATING ERP BENEFITS, COMPETITIVE PRIORITIES AND PERFORMANCE MEASURES

Oscar F. Bustinza, University of Granada, Spain
Email: oscarfb@ugr.es

Daniel Arias-Aranda, University of Granada, Spain
Email: darias@ugr.es

Vanesa Barrales-Molina, University of Granada, Spain
Email: vanesabm@ugr.es

Carmen Haro Dominguez, University of Granada, Spain

Nieves Perez Arostegui, University of Granada, Spain

ABSTRACT

Purpose: *Enterprise Resource Planning (ERP) systems are implemented to control the processes developed by the organisation through analysis of the allocation of resources within the firm. Although the benefits of implementing such systems have been determined, research on the relationship to firm performance has been limited to case studies and very specific papers based on some financial measures.*
Design/methodology/approach: *A survey is used to collect data. Empirical analysis utilises Structural Equation Modelling (SEM).*
Findings: *This investigation aims to study the appropriateness of ERP benefits to the firm's competitive priorities, based on the assumption that this appropriateness is what is responsible for its impact on firm performance measures. The results confirm the positive relationship of the benefits in operations, management and IT infrastructure that implementing an ERP system provides for the firm's competitive priorities.*
Originality/value: *The study confirms that there is a positive relationship between these benefits and a higher level of key performance measures, and that competitive priorities sometimes act as a mediator of this relationship.*

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

PROVIDING SEMANTIC INTERPRETATION TO OLAP QUERIES. APPLICATION TO HOSPITAL MANAGEMENT DATA WAREHOUSES.

Carlos Molina, Dept. Informatics, University of Jaen, Spain
Email: carlosmo@ujaen.es

Belén Prados-Suarez, Dpt. Languages and Informatics Systems, University of Granada, Spain
Email: belenps@ugr.es

Miguel Prados de Reyes, San Cecilio Hospital, Granada, Spain
Email: prados@decsai.ugr.es

Carmen Peña Yañez, San Cecilio Hospital, Granada, Spain
Email: carmenpy@decsai.ugr.es

ABSTRACT

Purpose: *The aim of this paper is to present a new methodology to enrich the analysis over data cubes in an OLAP system, allowing the system to add semantic interpretation to the query results adapted to the final user.*
Methodology: *Defining a semantic translation of a given value regarding a concrete range of values can be done by means of fuzzy logic. In the case of querying data cubes, the possible combinations of dimensions, levels and aggregation functions makes this range different for each query, so a static interpretation is not valid. We propose a way to supply a semantic interpretation that adapts itself to the query considering the granularity and the semantic of the used function.*
Findings: *We propose a mechanism that allows the representation of different semantic interpretations in data-cubes, in addition to their adaptation when querying. With it users are automatically provided with personalized and elaborated results that are adapted and really meaningful for their individual requirements. In addition, the mechanism allows an individual (the meaning of a value is independent of the other values) or comparative interpretation (the semantic compare each value with the others in the query).*
Practical Implications: *The accessibility improvements achieved allow the creation of simpler interfaces and improve the query over data-cubes from mobile devices allowing the user to interpret the results without needing to review all the values for the queries.*
Originality/Value: *As far as the authors know, there are proposals to interpret values in a natural way for user, but none of them are able to adapt it to the structure of the query and the functions used, so the user is limited to the considered cases. In our approach, the system will adapt the semantic after each query, providing the user with an easy and interpretable result. Even more, the system can adapt the results to different users in a very simple way.*

INTRODUCTION

Everyday more enterprises and big organizations require advanced methods providing managers with elaborated and comprehensible information. It is especially relevant in the cases of organizations working over OLAP systems due to the immense amount of information that is stored using datacubes.

This problem is relatively recent so there are not a lot of proposals that face this problem. Most of the existing techniques are focused on presenting the information to the user in a comprehensible language for him/her; i.e. in natural language. This is the case of the linguistic summary methods, that analyze great amount of data to provide the user with results of the "Q of the X verify the property Y" structure, where Q is a quantifier. However this is not enough when the user needs the result of the query to be semantically meaningful.

An example of this situation takes place when a manager of a group of health centers has to evaluate the performance of the medical doctors. This manager may query about the number of patients that are attended by a given doctor, obtaining, as a result the number of 15 patients per day. This value doesn't show whether this doctor works a lot or, otherwise, attends to very few patients. Therefore, it would be necessary to perform the query comparing the results with the attendance values of the other medical doctors working at the same center. With it the manager may get the conclusion that all the staff at the same center have a similar productivity; however, he/she still doesn't know if it is a good productivity or not: the value obtained doesn't have the same meaning if the health center attends to a small population than if it is at a big crowded city. Hence, to know if this number is appropriated, it would be necessary to perform a query comparing this value with the ones of the medical doctors working at other health centers with similar characteristics. In other words: 15 patients/day may be a good rate in a small center (where the productivity uses to be medium) but a bad rate in a big hospital (where the average productivity uses to be high or very high).

In this example the same user has performed three different queries over the same data but with distinct purposes, each requiring a different interpretation according to the granularity of the information with which this data is compared.

The research field closer to the problem of the meaning of the queries is, as mentioned above, the linguistic summary field. According to Bouchon-Meunier, B. & Moyse [1], proposals in this scope can be categorized in two groups. On the one hand can be found the proposals using fuzzy logic quantifiers [2-8], on the other hand, proposals based on nature language generation NLG [9-14].

Nevertheless, all of these techniques doesn't take into account the granularity of the information and just tell the user "how many of the X verify Y", when what the user really wants is to analyze the same data item from different points of view (alone, compared with a small set or with a bigger set) each with a different meaning.
This is why in this paper we introduce the concept of *Semantic Interpretation* of the results of queries on a datacube. To this purpose in section 2 we present the multidimensional model used as reference, whereas in section 3 we describe the notion of *semantic interpretation*.

MULTIDIMENSIONAL MODEL

The base for the semantic interpretation is a multidimensional model to store the data and query it. In this section we briefly present the model. A detailed definition can be found in [16,17].

1. Multidimensional Structure

In this section we present the structure of the fuzzy multidimensional model.

Definition 1. A dimension is a tuple $d=(l,\leq_d,l_\perp,l_\top)$ where $l=\{l_i,\ i=1,...,n\}$ so that each l_i is a set of values and $l_i \cap l_j=\emptyset$ if $i\neq j$, and $\leq_d$ is a partial order relation between the elements of l. $l_\perp$ and $l_\top$ are two elements of l so that $\forall l_i \in l\ l_\perp \leq_d l_i$ and $l_i \leq_d l_\top$.
We denote *level* to each element l_i. To identify the level l of the dimension d we will use $d.l$. The two special levels $l_\perp$ and $l_\top$ will be called *base level* and *top level* respectively. The partial order relation in a dimension is what gives the hierarchy relation between the levels.

Definition 2. For each dimension d the domain is $dom(d)=\bigcup l_i$.

Definition 3. For each l_i the set

$$H_{l_i} = \{l_j / l_j \neq l_i \wedge l_j \leq_d l_i \wedge \neg\exists l_k \quad l_j \leq_d l_k \leq_d l_i\} \tag{1}$$

We call it *set of children of the level l*.
Definition 4. For each l_i the set

$$P_{l_i} = \{l_j / l_i \neq l_j \wedge l_i \leq_d l_j \wedge \neg\exists l_k \quad l_i \leq_d l_k \leq_d l_j\} \tag{2}$$

And we call it *set of parents of the level l*.
Definition 5. For each pair of levels l_i and l_j so that $l_j \in H_{l_i}$ we have the relation

$$\mu_{ij} : l_i \times l_j \rightarrow [0,1] \tag{3}$$

We call it *kinship relation*.

The degree of inclusion of the elements of a level in the elements of their parent levels can be defined using this relation. If we use only the values 0 and 1 and we only allow an element to be included with degree 1 by a unique element of its parent levels, this relation represents a crisp hierarchy. If we relax these conditions and we allow to use values in the interval [0,1] without any other limitation, we have a fuzzy hierarchy relation. This allows the representation of several hierarchy relations in a more intuitive way. Furthermore, this fuzzy relation allows the definition of hierarchies in which there is imprecision in the relationship between elements in different levels. In this situation, the value in the interval shows the degree of confidence in the relation.

Definition 6. For each pair of levels l_i and l_j of the dimension d so that $l_j \leq_d l_i \wedge l_j \neq l_i$ we have the relation $\eta_{ij} : l_i \times l_j \rightarrow [0,1]$ defined as

$$\eta_{ij}(a,b) = \begin{cases} \mu_{ij}(a,b) \quad if \quad l_j \in H_{l_{ii}} \\ \bigoplus_{l_k \in H_{l_i}} \bigoplus_{c \in l_k} (\mu_{ik}(a,c) \otimes \eta_{kj}(c,b)) \quad in \quad other \quad case \end{cases} \tag{5}$$

Where $\oplus$ and $\otimes$ are a t-norm and a t-conorm respectively or operators from the families MOM and MAM defined by Yager ([15]), that include the t-norms and t-conorms. We call this *extended kinship relation*.
This relation gives us information about the degree of relation between two values in different levels inside the same dimension. To obtain this value, it considers all the possible paths between the elements in the hierarchy. Each one is calculated aggregating the kinship relation between elements in two consecutive levels using a t-norm. Then the final value is the aggregation of the result of each path using a t-conorm.

Definition 7. We call *fact* to any pair (h,α) where h is a m-tuple over the domain of the attributes we want to analyze, and $\alpha \in [0,1]$.

The management of uncertainty in the facts is carried out using a degree of certainty with each one. This degree of certainty allows us to use values in analysis that can be interesting to the decider but imply imprecision.

Definition 8. An object of type *history* is the recursive structure

$$H = \begin{cases} \text{Ø} \\ (\text{A}, \text{l}_\text{b}, F, G, H') \end{cases} \tag{7}$$

Where
- Ø is a special symbol.
- F is a set of facts.
- l_b is a set of levels $(l_{1b},...,l_{nb})$.
- A is an application from l_b to F
- G is an aggregation operator.
- H' is a structure of type *history*.

Definition 9. A datacube is a tuple $C=(D,l_b,F,H,A)$ so that $D=(d_1,...,d_n)$ is a set of dimensions, $l_b=(l_{1b},...,l_{nb})$ is a set of levels so that l_{ib} belongs to d_i, $F = RU\text{Ø}$ where R is the set of facts and Ø is a special symbol, H is an object of type *history*, and A is an application defined as $A : l_{1b} \times ... \times l_{nb} \rightarrow F$.

If for a $\vec{a} = (a_1,...,a_n)$ we have $A(\vec{a}) =$ Ø, this means that there isn't defined a fact for this combination of values.

Definition 10. We say a datacube is *basic* if $l_b = (l_{1\perp},...,l_{n\perp})$ and H= Ø.

2. Operations

Once we have the structure of the multidimensional model, we need the operations to analyse the data in the datacube. In this section we present the normal operations (roll-up, drill-down, slice, dice and pivot) over the structure proposed. In section 3 we present an example of the application of these operations over a multidimensional schema.

Definition 11. An aggregation operator G is a function $G(B)$ where $B = \{(h,\alpha)/(h,\alpha) \in F\}$ and the result is a tuple (h', α').

The parameter that operator needs can be seen as a fuzzy bag ([6]). In this structure there is a group of elements that can be duplicated, and each one has a degree of membership.

Definition 12. For each value a belonging to d_i we have the set

$$F_a = \begin{cases} \bigcup_{l_j \in H_{l_i}} F_b / b \in l_j \wedge \mu_{ij}(a,b) > 0 & \text{if} \quad l_i \neq l_b \\ \{h / h \in H \wedge \exists a_1,...,a_n A(a_1,..,a,...,a_n) = h\} & \text{if} \quad l_i = l_b \end{cases} \tag{11}$$

The set F_a represents all the facts that are related to the value a.
With this structure, the basic operations over datacubes are defined: *roll-up*, *drill-down*, *dice*, *slice* and *pivot* (see [16] for definition and properties).

SEMANTIC INTERPRETATION

In this section we present the inclusion of semantic interpretations in the fuzzy multidimensional model and the query process using them. Next section presents the structure of the semantic interpretations. Section 3.2 studies the aggregation functions related to the semantic of the results. The last section presents the process of the query.

1. Structure

A *Semantic Interpretation* (SI) is a structure associated to each fact. Its elements are:

- $L=\{L_1,...,L_m\}$: a set of linguistic labels over the basic domain. The set doesn't have to be a partition but this characteristic is desirable.
- $f_a(L,c)$: a function to adapt the labels in L to a cardinality c. As c can be a fuzzy set the function has to be able to work with this kind of data. The function f_a has to be continuous and monotone.
- $G=\{G_1,...,G_n\}$: a set indicating the aggregation functions that keep the semantic interpretation.

Multiple SI can be associated to each measure. On each fact we have to store as a metadata the cardinality associated to the value. This cardinality means the number of values that were aggregated to obtain this value.
When a value is going to be shown, the system applies the semantic interpretation to translate the value into a label. In this process we can differentiate two different approaches:

1. *Independent interpretation.* In this situation each value is studied without considering the context (the rest of the values) so we obtain an independent interpretation of the value. In this case, the cardinality to adapt the labels is the one stored in the value.
2. *Relative interpretation.* In this case, the values are compared with the other facts in the query so the interpretation is relative to the complete query. Hence the cardinality to adapt the labels depends on the complete set of values. In this case, the system calculates the average cardinality of all the values and uses this cardinality to adapt the labels.

2. Aggregation functions

Aggregation functions have an important role in the query process and in the semantic of the results. In this section we will study the different aggregation function types we can find according to the cardinality of the results and if a change of semantic occurs.

Let be a set of value $V=\{v_1,...,v_m\}$, of which set of cardinality is $C=\{n_1,...,n_m\}$, considering these two factors, we can classify the functions in three categories:

1. *Aggregators.* These functions aggregate the values and the cardinality is the sum of the cardinalities of each value:
$$c = \sum_{i=1}^{m} n_i$$
The only aggregation function that satisfies this behaviour is the SUM.
2. *Summaries.* In that case, the functions take a set of values and obtain a value that summarizes the complete set. Then the cardinality has to represent the average cardinality of the values.
$$c = \frac{\sum_{i=1}^{m} n_i}{m}$$
Most of the statistic indicators are in this category (maximum, minimum, average, median, percentiles, etc.).
3. *Others.* These functions represent a complete change of the semantic of the values so the result has to be considered in a new domain. In that case, the cardinality should be established to 1.
$$c=1$$
In this category we find functions like the variance or the count.

Once we have studied the aggregation functions we have all the elements to show the query process with the semantic interpretations.

3. Query process

In this section we present the query process considering the use of the SI. We can differentiate two phases on the query process: the OLAP query over the datacube and the report with the results. In both phases the SI are involved in a different way. Let show the process on each one:

1. *Query over the datacube*. In this phase is where the values/cardinalities are calculated. Inside this process we have to calculate the metatada of each one so, in the next phase, the values can be shown using the SI. The cardinality is calculated over each value considering the aggregation function used as shown in section 3.3.
In this process the system has to control whether the semantic has changed or not. On each value the system checks if the aggregation function used is in the set *G* of each *SI*. If the function is not included, then this *SI* is deleted. In next phase (the report) the user can only use the *SIs* that satisfy this restriction.
2. *Report*. Once the query has finished the result is shown to the user in a report. In this process the user has to choose the way to represent the values (the *SI* to use) and the interpretation (independent or relative as shown in section 3.1). After these steps, the

system adapts the labels of each value using the f_a functions and the right cardinality (the absolute or the average).

LEARNING THE f_a FUNCTIONS

In the previous section we have presented the query process using SI. One of the phases adapts the labels in L so they are fitted to the new cardinality. This process is carried out using the f_a function. The quality of the result will depend on this function, so an important point is the process to define it.
Asking the user for that function is not always possible because most of the times the user is not able to use a mathematical expression to define his/her interpretations. This is why we propose to learn the functions, following the next steps:

1. First we ask the user for an interpretation over the basic domain so we can define the set L of labels over it.
2. To learn the function now the system runs some queries over the datacube showing the results.
3. For each query the system asks the user to associate a label of L to the value. The system then stores the associations and the cardinalities of each value.
4. With these associations the system tries to fit a function that satisfies the interpretation with the corresponding cardinality. In this process, the system will try continuous and monotone functions to adapt the labels. If the fitted function has good quality (the adapted labels correspond to the labels associated by the user) the process ends. In other case, the process goes on but to point 2 to show more queries so the system gets more data to fit the function.

EXAMPLE

In this section we will present a small example to show in detail the proposed method. Let us suppose we have a simple datacube with only two dimensions (time and centre) and only one measure (number of patients). The hierarchies for both dimensions are shown in Figure 1.

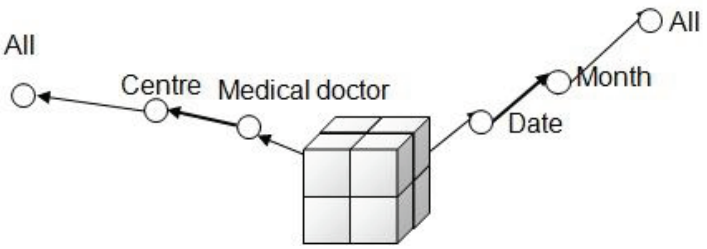


Figure 1: Example datacube

For the measure we define a *SI* indicating if the number of patients attended by a doctor is *Low*, *Normal* or *High*. At base level (doctor and day) the fuzzy partition is shown in Figure 2.

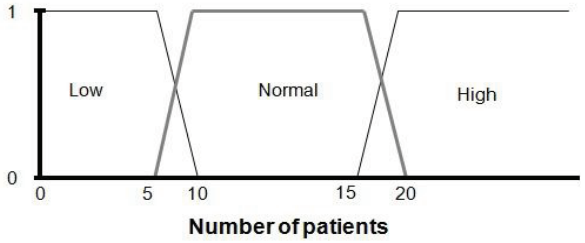


Figure 2: Fuzzy partition over the measure Number of Patients

The *SI* is valid for aggregations like sum and average. The last aspect to define is the f_a function. In this example we suppose that it is lineal and just multiply the points of the fuzzy label by the new cardinality (e.g. if Low is defined as (0,0,5,10) for one doctor in a day, for two doctors the label will be (2x0,2x0,2x5,2x10)=(0,0,10,20)).

Let us suppose that we have two centres with different size. One (*C1*) is placed in a city and there are 500 medical doctors in the staff. The second one (*C2*) is placed in a small village and only 10 doctors are working in that centre. If a manager asked the system to calculate the number of patients attended by both centres each month we can get a table like that

Table 1: Query result

Centre	Month	Patients
C1	January	125.000
C1	February	130.000
...	...	...
C2	January	4.200
C2	February	5.000
...	...	...

The table shows very different results for each centre and it is not easily interpretable due to the differences in the size of each one. Applying our proposal we obtain the label that best represents each value.

For centre C1 we have to calculate the cardinality of the result so we can adjust the labels. We have the data defined to doctor and day so, for each month we have to aggregate the values for 500 medical doctors and 20 working days for month. Therefore the cardinality is 500x20=10.000. We adjust the fuzzy partition for this new cardinality as shown in Figure 3. In the case of centre *C2* then the cardinality is 10x20=200 (Figure 4).

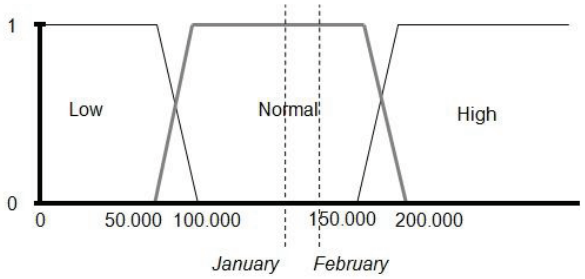


Figure 3: Labels adaptation for query for centre C1

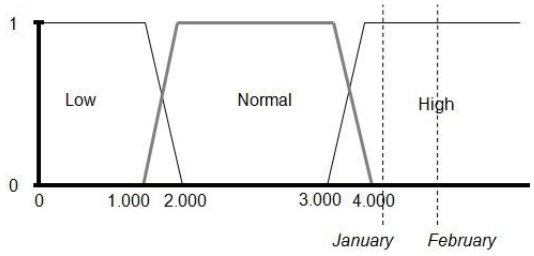


Figure 4: Labels adaptation for query for centre C2

In the figures 3 and 4 we have indicated the values for the Table 1, so we have the labels associated to each result. In Table 2 we have added the label associated to each value.

Table 2: Query results using Semantic Interpretation

Centre	Month	Patients	***Label***
C1	January	125.000	*Normal*
C1	February	130.000	*Normal*
...	...	...	...
C2	January	4.200	*High*
C2	February	5.000	*High*
...	...	...	...

As can be seen using the *Semantic Interpretations* in the example it is appreciated how the values are adapted so the user has the interpretation (the meaning) of the values directly.

CONCLUSIONS

In this paper we have introduced the new concept of *Semantic Interpretation,* that provides the OLAP systems with the new capability of querying about the same given item with different purposes obtaining in each case a result with a different meaning. With our proposal, the semantic of the results of the query can be distinct and adapted to the needs of the user, by taking into account the granularity of the information considered.

We also have formalized the concept of *SI* and provide the formulation to apply over a multidimensional model using the normal OLAP operations.

REFERENCES

1. Bouchon-Meunier, B. & Moyse, G. Fuzzy linguistic summaries: Where are we, where can we go? Computational Intelligence for Financial Engineering Economics (CIFEr), 2012 IEEE Conference on, 2012, 1-8
2. R. R. Yager, "A new approach to the summarization of data," Information Sciences, vol. 28, no. 1, pp. 69-86, Oct. 1982.
3. L. Zadeh, "A computational approach to fuzzy quantifiers in natural languages," Computers & Mathematics with Applications, vol. 9, no. 1, pp. 149-184, 1983.
4. R. R. Yager, "Fuzzy summaries in database mining," in Proceedings the 11th Conference on Artificial Intelligence for Applications, 1995, pp. 265-269.

5. J. Kacprzyk, A. Wilbik, and S. Zadrozny, "Linguistic summarization of time series using a fuzzy quantifier driven aggregation," Fuzzy Sets and Systems, vol. 159, no. 12, pp. 1485-1499, Jun. 2008.
6. L. Liétard, "A new definition for linguistic summaries of data," in 2008 IEEE International Conference on Fuzzy Systems (IEEE World Congress on Computational Intelligence), 2008, pp. 506-511.
7. P. Bosc, L. Liétard, and O. Pivert, "Extended functional dependencies as a basis for linguistic summaries," Lecture notes in computer science, pp. 255-263, 1998.
8. D. Rasmussen and R. R. Yager, "Finding fuzzy and gradual functional dependencies with SummarySQL," Fuzzy Sets and Systems, vol. 106, no. 2, pp. 131-142, Sep. 1999.
9. Yseop, "Faire parler les chiffres automatiquement," 2011. [Online]. Available: http://www.yseop.com/demo/diagFinance/FR/.
10. S. Sripada, E. Reiter, and I. Davy, "SUMTIME-MOUSAM: Configurable Marine Weather Forecast Generator." 2003.
11. J. Yu, E. Reiter, J. Hunter, and S. Sripada, "SumTime-Turbine: A Knowledge-Based System to Communicate Gas Turbine Time-Series Data," in The 16th International Conference on Industrial & Engineering Applications of Artificial Intelligence and Expert Systems, 2003, p. 23-26.
12. L. Danlos, F. Meunier, and V. Combet, "EasyText: an Operational NLG System," in ENLG 2011, 13th European Workshop on Natural Language Generation, 2011.
13. E. Goldberg, N. Driedger, and R. . I. Kittredge, "Using natural-language processing to produce weather forecasts," IEEE Expert, vol. 9, no. 2, pp. 45-53, Apr. 1994.
14. F. Portet, E. Reiter, J. Hunter, and S. Sripada, "Automatic generation of textual summaries from neonatal intensive care data," in 11th Conference on Artificial Intelligence in Medicine (AIME '07), 2007, p. 227-236.
15. Yager, R.R.: Aggregation Operators and Fuzzy Systems Modeling. Fuzzy Sets and Systems 67 (1994) 129-145
16. Molina C, Rodriguez-Ariza L, Sanchez D, Vila A. A New Fuzzy Multidimensional Model. Fuzzy Systems, IEEE Transactions on. 2006;14:897 -912
17. Delgado M, Molina C, Rodríguez Ariza L, Sanchez D, Vila A. F-Cube Factory: a fuzzy olap system for supporting imprecision. International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems [Internet]. 2007;15:59-81

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

RULE GENERATION BASED ON NOVEL TWO-STAGE MODEL

Kuo-Ping Lin, Department of Information Management, Lunghwa University of Science and Technology, Taoyuan 333, Taiwan
Email: kplin@mail.lhu.edu.tw

Ching-Lin Lin, Department of Information Management, Lunghwa University of Science and Technology, Taoyuan 333, Taiwan

Yu-Ming Lu, Department of Information Management, Lunghwa University of Science and Technology, Taoyuan 333, Taiwan

Ping-Feng Pai, Department of Information Management, National Chi Nan University,University Rd., Puli, Nantou 545, Taiwan

ABSTRACT

Purpose *– The purpose of this paper is to develop a novel two-stage model for promoting the effect of rule generation based on rough set. In order to improve traditional rough set method, the novel two-stage model adopts new kernel intuitionistic fuzzy clustering (KIFCM) to promote performance of rough set theory. Moreover, the e-learning customer data set in Taiwan is also examined for demonstrate the effectiveness and practicality of model.*

Design/methodology/approach *– In this paper, the authors present a new kernel intuitionistic fuzzy rough set model which combines novel KIFCM with rough set. The rule generation can divide to two stages for effective rule generation. In the first stage, KIFCM can utilize the advantages of kernel function and intuitionistic fuzzy sets to cluster raw data into similarity groups. In the second stage, the rough set theory is employed to generate rules with different groups. Finally, based on decision rules of rough set with different groups the results of system can be obtained and analyzed for users.*

Findings *– The novel rule generation model adopts pre-process, which is KIFCM clustering technique, can effectively assist traditional rough set in promoting the performance. In analysis of e-learning data set, the empirical result indicates that proposed novel rule generation model can outperform traditional decision models.*

Practical implications *–This novel two-stage model can provide a new and effective technique for data mining, database system, ..., etc. Furthermore, in the research, proposed model also practically was applied to analyze and model customer's tendency in e-learning platform with proper decision rules.*

Originality/value *– The rough set theory has widely used in dealing with data mining and classification problems. This research proposes a construct of novel two-stage model which can effectively improve traditional rough set theory by using KIFCM clustering technology in the first stage. Real e-learning data set also is employed for demonstrate the effectiveness and practical. Based on the empirical result, the novel two-stage model can be evidenced that can actually apply in real information platform.*

Keywords: Rule generation, rough set, kernel intuitionistic fuzzy clustering, e-learning

INTRODUCTION

Rough set theory (RST) (Pawlak, 1982; Pawlak, 1991) is useful in analysis of inconsistent decision tables composed of attribute value data about many objects. The RST is a mathematical tool to deal with vagueness and uncertainty. In RST we can extract the minimal attribute sets without deterioration of quality of approximation, and minimal length decision rules corresponding to lower or upper approximation. This approach has been one of fundamental important in artificial intelligent (AI) especially in the fields of machine learning, knowledge acquisition, decision support system, medical information, and pattern recognition. Table 1 summarized some developments of rough set-based rule generation technology since 2000.

Beynon et al. (2000) used variable precision rough set (VPRS), which suggested by Ziarko (1993a, 1993b), to analyze expenditure on elementary and secondary education at the US state level. The standard linear discriminant analysis (LDA) also was employed in the same example. The result show the VPRS has good performance in classification accuracy index and indicates that rules based on rough set may be evaluated in various ways, some of which are analogous to certainty factors in standard rule-based method. Khoo and Zhai (2001) proposed an integrated prototype system (RClass-Plus) that combines rough set theory, genetic algorithms and Boolean algebra, for inductive learning. The prototype system was validated using the state of machine case that result shows the RClass-Plus has better capabilities, which are respectively dealing with uncertainty and inconsistency, simple and concise rules induction, and extracting complete rules, than iterative

dichotomiser 3 (ID3) (Quinlan, 1986), learning from examples based on rough sets (LERS) (Grzymala-Busse, 1992), and rough-set-based approach for classification (RClass) (Khoo et al., 1999). Mak and Munakata (2002) reviewed and compared the rule extraction capabilities of rough sets with neural networks and ID3. This research indicated the rough set method offers much better explanatory capability than the neural network method and distills the data into a set of simple and usable rules. In new Product entry decision case the result also shows the rough set can obtain better performance in predictive accuracy index than neural networks and ID3. Pal et al. (2003) proposed a Rough-fuzzy multilayer perceptron (Rough-fuzzy MLP) with modular concept using a genetic algorithm to obtain a structure network suitable for both classification and rule extraction. Four compared methods, which are *Subset* method (Fu, 1993), *M* of *N* method (Towell and Shavlik, 1993), X2R (Liu and Tan, 1995), and decision tree-based method C4.5 (Ross Quinlan, 1993), were also examined in vowel, pat, medical data sets. The effectiveness of the Rough-fuzzy MLP model is extensively demonstrated in these data sets. Hou and Huang (2004) used fuzzy variable precision rough set approach to manufacturing process. The induced rules are compared with the rules by the traditional rough set. The fuzzy rough set approach, being less sensitive to noisy data, induces better rules than traditional rough set approach. Tseng et al. (2005) used rough set to predicting quality characteristic in machining operations. The results indicate a higher accuracy over traditional the tradition multi-nominal regression and general discriminant methods. Pattaraintakorn et al. (2006) proposed an ordinal prediction based on rough sets and soft computing which illustrates the formulation of more meaningful rules using the notion of ordinal prediction. The results are the rules that are constructed from the interval antecedents and are able to predict intervals rather than unique values of the target function. Wang et al. (2006) used rough set attribute reduction algorithm that employed particle swarm optimization (PSO) to find minimal rough set reducts, and compared with neural networks, decision trees and a fuzzy rule extraction algorithm based on Fuzzy Min-Max Neural Networks (FRE-FMMNN). The result shows that reducts found by rough set attribute reduction algorithm were more efficient and generated decision rules with better classification performance. Inuigchi and Miyajima (2007) proposed a rule induction based on rough set from two decision tables. The research pointed out decision rule is positively supported by a decision table and does not have any conflict with the other decision table and a second level decision rule is positively supported by both decision tables. Hong et al. (2007) proposed a hybrid fuzzy rough set system using fuzzy lower and upper approximations transform each quantitative value into a fuzzy set of linguistic term. The certain and possible rules are then generated based on these fuzzy approximations. Teoh et al. (2008) proposed a hybrid fuzzy time series model for stock index forecasting based on cumulative probability distribution

approach (CPDA) and rough set rule induction. Two empirical stock markets (TAIEX and NYSE) were used as evaluating database, and two methodologies (Chen, 1996; Yu, 2005) are used as comparison models. The result shows hybrid fuzzy time series model has outperformance in the two examples. Qian et al. (2008) proposed a rule extracting algorithm based on the converse approximation which can be named REBCA is designed to extract decision rules from a decision table. Fan et al. (2009) proposed an incremental rule-extraction algorithm based on the previous rule extraction to resolve there aforementioned issues, and successfully applied in lager database. Ma et al. (2009) proposed a classification algorithm named Rule Generation based on Classification Attribute (RGCA) to deduct negative and positive rules. The results show the classification accuracy of RGCA algorithm is better than traditional positive based algorithm in examples of Machine learning databases. Luo and Zhong (2010) used rough set data mining method for knowledge acquisition and decision-making reasoning method, and applied in Medical Expert Diagnosis System (MEDS). Othman et al. (2011) developed a data mining approach of integrated-rough-set-and-genetic-algorithm based rule discover from digital protective relay's resident event report. This integrated approach has been proven to be an exact manifestation of real operation characteristics hidden in the event report, and has better performance than decision tree based analysis. Shi et al. (2012) adopted rough sets theory to reduce features and associate rule mining in KANSEI Engineering. The case of mobile phone was examined and indicated that rough sets theory can obtain better performance than orthogonal method. Huang et al. (2013) proposed incremental rough set theory based rule induction and applied to customer preferred estimation in the cell phone purchase.

Observation of past research of RST can be concluded some phenomenons (1) Recently RST can effectively apply in various areas. (2) RST can obtain better performance than some popular method such as decision tree (ID3 and C4.5), and neural networks. (3) Some researches proposed hybrid RST-based methods which can successfully improve performance of RST.

Table 1. Some developments of rough set-based rule generation technology since 2000.

Author(s)	Year	Technology	Applied problem	No. of condition attribute	Compared method(s)
Beynon et al.	2000	VPRS	Expenditure on elementary and secondary education	8	LDA
Khoo and Zhai	2001	RClass-Plus	State of machine	3	ID3, LERS, and RClass
Mak and Munakata	2002	Rough set	New Product entry decision	3	ID3, and neural networks
Pal et al.	2003	Rough-fuzzy MLP	Vowel/ Pat/ Medical	6/ 2/ 11	Subset method, M of N method, X2R, and C4.5
Hou and Huang	2004	Fuzzy rough set	Manufacturing process	8	Rough set
Tseng et al.	2005	Rough set	Machining operations	8	Multi-nominal regression, and general discriminant
Pattaraintakorn et al.	2006	Rough set with notion of ordinal prediction	Melanoma data set	7	—
Wang et al.	2006	Rough set	Brain glioma	14	Neural networks, decision trees and FRE-FMMNN
Inuigchi and Miyajima	2007	Rough set	Evaluation of television set	3	—
Hong et al.	2007	Rough set and fuzzy set theory	Fisher's Iris Data	4	—
Teoh et al.	2008	Rough set	Trading stock	1/1	Chen's method

Author(s)	Year	Technology	Applied problem	No. of condition attribute	Compared method(s)
		and CPDA	index/trading database		(1996) and Yu's method (2005)
Qian et al.	2008	REBCA	Numerical example	4	—
Fan et al.	2009	Incremental rough set	Information system	4	—
Ma et al.	2009	RGCA	Lens/ Balloons/ Iris/ Wine (Machine learning databases)	6/4/4/4	—
Luo and Zhong	2010	Rough set	MEDS	9	—
Othman et al.	2011	Rough set and genetic algorithm	Power protection system maintenance	30	Decision tree
Shi et al.	2012	Rough set	KANSEI Engineering	9	Orthogonal method
Huang et al.	2013	Rough set	Customer preferred estimation	4	—

—: means non.

This paper therefore aims to develop a novel two-stage model for promoting the effect of rule generation based on novel KIFCM and RST because accurately generating decision rules can effectively discover and construct domain's knowledge. In the first stage, clustering technology is utilized to classify the pattern datasets. This research develops a novel KIFCM which can be evidenced obtains good performance in numerical example. The results of this novel clustering can roughly class similar pattern into the same group. This stage can effectively reduce complexity of pattern datasets. Based on the results of stage one, the RST, which has been widely applied in the rule generation, is employed as the main rule generation technology in stage 2. With different groups, RST can further obtain better performance. Furthermore, this research adopts two types numerical example to examine proposed novel two-stage model.

The rest of this paper is organized as follows. Section 2 presents the main construct of novel two-stage model for rule generation, and introduces novel KIFCM and RST respectively. Section 3 depicts machine learning datasets and real e-learning case, experimental results, and compares

with various models. Section 4 presents the research summary and conclusions.

NOVEL TWO-STAGE MODEL

The design construct of novel **two-stage** model. This model main adopts kernel intuitionistic fuzzy clustering and rough set in stages 1 and 2, respectively. Firstly, KIFCM can utilize the advantages of kernel function and intuitionistic fuzzy sets to cluster raw data into similarity groups. Traditional fuzzy clustering techniques could not effectively solve multi-variables or nonlinear problems. Kernel-based methods have attracted great attention and have been applied in many fields (Vapnic, 1998; Graves and Pedrycz, 2010; Lin et al., 2011; Zhang and Chen, 2004). The kernel-based method involves performing an arbitrary nonlinear mapping data from the original dimensional feature space to a higher dimensional space, called kernel space. In the kernel space the original data may apply classifiers. The use of kernels has received considerable attention because kernels make it possible to map data onto a high-dimensional feature space in order to increase the representation capability of linear machines. Moreover, KIFCM incorporates another uncertainty which is the hesitation degree that arises while defining the membership function. When hesitation degrees are used for determining precisely membership function because Yager class of IFSs (hesitation degrees) can assist to amplify differentiation of clusters, this is done to maximize the good points in the class. The KIFCM can obtain the advantages of both.

Secondly, the rough set theory is employed to generate rules with different groups. Rough set is a powerful tool to solve vagueness and uncertainty problems, which is suitable to analyze quantitative attributes and qualitative ones. A principle task, in the rough set of rule generation, is to compute reducing relative to a particular kind of information system, the decision system. Finally, based on decision rules of rough set with different groups the results of system can be obtained and analyzed for users. The illustration of novel kernel intuitionistic fuzzy rough set model is shown in Figure 1:

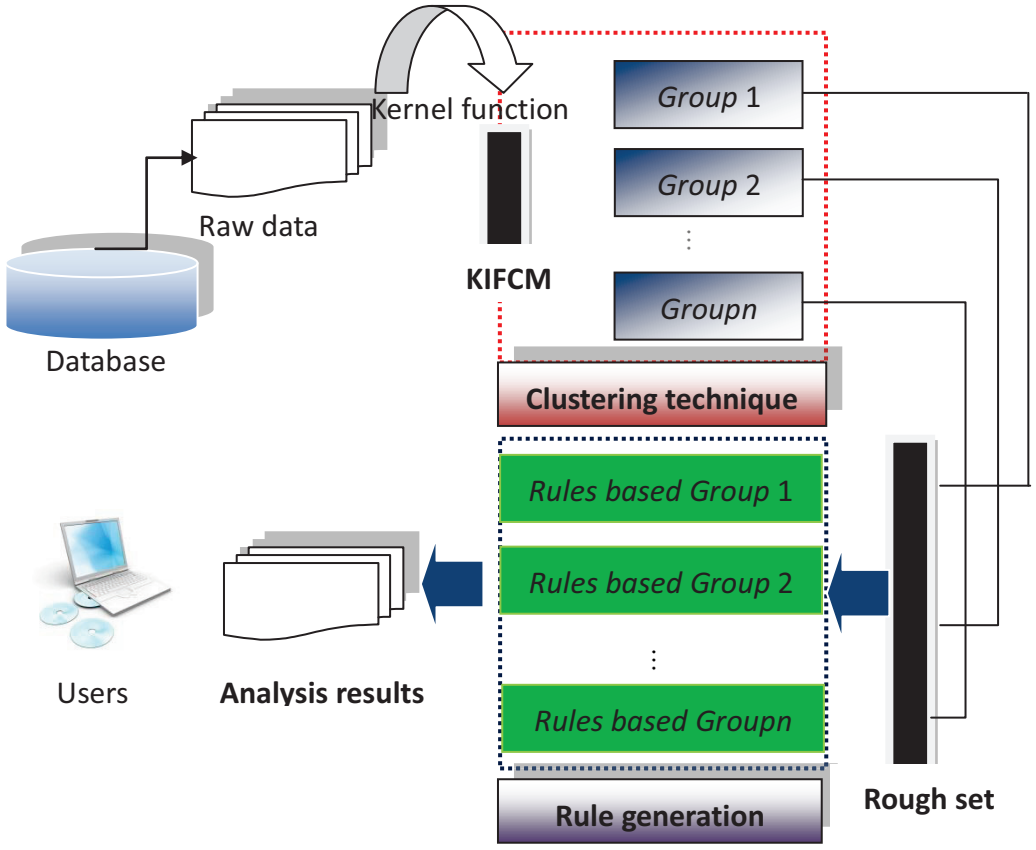


Figure 1. The structure of two-stage model for rule generation and extraction

The procedures can be described as follows.

Step 1: The data of selected variables can be obtained from a database. These selected data are based on expert opinion.

Step 2: (Stage one) In the first stage, the fuzzy clustering methods: novel KIFCM can be employed, help to define similar pattern into groups. These groups approximately represent the pattern that may have common variables and similarity characters; based on the groups, the pattern datasets can reduce interactive complexity.

Step 3: (Stage two) In the second stage, the two-stage model uses the RST to rule generation in various groups. The RST model can generate and discover decision rules in various groups, and subsequently provide more creditable rules and analysis.

Step 4: This research adopts three measuring index. Firstly, accuracy rate (J_1) can be introduced as following:

$$J_1 = 100 \times \frac{N_{correct}}{Data_{total}} \quad (1)$$

where $N_{correct}$ is number of correct classification of data, and $Data_{total}$ is total number of data. Second, coverage rate (J_2), and a comprehensive index (J), which is equal to $J_1 + J_2$, to measure the performance. The coverage rate can be formulated as following:

$$J_2 = \frac{N_{coverage}}{Data_{total}}, \quad (2)$$

where $N_{coverage}$ is number of coverage data by generating rules.

1. Kernel intuitionistic fuzzy *c*-means clustering algorithm

Clustering analysis involves the discovery of a data structure and partitions a data set into a number of subsets with correlated data. Clustering was widely applied in several fields, such as taxonomy, geology, business, engineering systems, medicine, and image processing (for example, Bezdek, 1981; Yang, 1993; Honda and Ichihashi, 2004; Kohonen, 1997; Liu and Wang, 2007). FCM is one of the most widely employed techniques. In FCM and fuzzy clustering concepts, the membership function of clusters can be defined based on a distance function, and thus, the degrees of memberships may express the proximity of the data to the multi-cluster centers. The proposed KIFCM considers the kernel function and IFSs that the KIFCM attempts to maximize the good points in the kernel space. The procedures of KIFCM can be described as following:

***Step*1 (Input parameters)**: The input parameters are number of clusters to classify (c), parameter in updating the clustering membership functions (m), parameter of Yager's intuitionistic fuzzy complement (α), number of epochs to carry out (k), parameter of Gaussian kernel (σ), and tolerance for the solution accuracy (δ) respectively.

***Step* 2 (Generating initial membership and center):** By the KIFCM, the initial memberships of the data $\boldsymbol{x}_i$, $i = 1, \ldots, N$, with the crisp input-output to the clusters j ($j = 1, \ldots, c$) are generated randomly and denoted as $U(k) = [\mu_{ij}^{(k)}]_{N\times c}$ ($k = 0$) under $\sum_{\forall j} \mu_{ij}^{(k)} = 1 \forall i$. By generating randomly

memberships of the data in KIFCM, the center $C_j^{(k)}$ can be easily calculated.

***Step* 3 (Calculating objective function)** : With a data set $\boldsymbol{x}_i$, KIFCM, the modified objective function of the fuzzy c-means using the kernel space and IFSs need to be minimized. Therefore, KIFCM minimizes the following designed objective function:

$$J_{KIFCM} = \sum_{j=1}^{c}\sum_{i=1}^{N}\left(\mu_{ij}^{(k)}\right)^m \times \left\|\varphi(\boldsymbol{x}_i), \varphi(C_j^{(k)})\right\|^2 \quad (3)$$

where $\left\|\varphi(\boldsymbol{x}_i), \varphi(C_j^{(k)})\right\|^2$ is the Euclidean distance between $\varphi(\boldsymbol{x}_i)$ and $\varphi(C_j^{(k)})$, and $\varphi(\boldsymbol{x}_i)$ and $\varphi(C_j^{(k)})$ are the kernel spaces of $\boldsymbol{x}_i$and $C_j^{(k)}$, respectively. The squared distance is computed in the kernel space using a kernel function, as follows (Shen et al., 2006; Zhang and Chen, 2003):

$$\left\|\varphi(\boldsymbol{x}_i), \varphi(C_j^{(k)})\right\|^2 = K(\boldsymbol{x}_i, \boldsymbol{x}_i) + K(C_j^{(k)}, C_j^{(k)}) - 2K(\boldsymbol{x}_i, C_j^{(k)}) \quad (4)$$

In previous research, the Gaussian kernel was employed almost exclusively because the kernel function can obtain better performance with a Gaussian kernel function (Graves and Pedrycz, 2010). The Gaussian kernel can be expressed as $K(x_i, x_j) = \exp(-\left\|x_i - x_j\right\|_2^2 / \sigma^2)$. Therefore, with a Gaussian kernel function, the designed objective function can be written as

$$J_{KIFCM} = 2\sum_{j=1}^{c}\sum_{i=1}^{N}\left(\mu_{ij}^{(k)}\right)^m \times (1 - K(\boldsymbol{x}_i, C_j^{(k)})) \quad (5)$$

***Step* 4 (Updating membership and center)** : The optimization of the partition matrix U involves the use of Lagrangian multipliers, leading to the expression

$$\mu_{ij}^{(k+1)} = \frac{(1/(1 - K(\boldsymbol{x}_i, C_j^{(k+1)})))^{(1/(m-1))}}{\sum_{h=1}^{c}(1/(1 - K(\boldsymbol{x}_i, C_h^{(k+1)})))^{(1/(m-1))}} \quad (6)$$

To incorporate intuitionistic fuzzy properties in the kernel fuzzy c-means algorithm, the hesitation degree is calculated initially by $\pi_A(x) = 1 - \mu_A(x) - (1 - \mu_A(x)^\alpha)^{1/\alpha}$., and the intuitionistic fuzzy

membership values are obtained as follows:

$$\mu_{ij}^{(l+1)*} = \mu_{ij}^{(l+1)} + \pi_{ij}^{(l+1)} \tag{7}$$

where $\mu_{ij}^{(l+1)*}$ denotes the intuitionistic kernel fuzzy membership of the *i*th data in the *j*th class.

By Eq.(7) in KIFCM, the prototypes $C_j^{(k+1)*}$ with the Gaussian kernel function can be written as

$$C_j^{(k+1)*} = \frac{\sum_{i=1}^{N} \mu_{ij}^{(k+1)} K(x_i, C_j^{(k+1)}) x_i}{\sum_{i=1}^{N} \mu_{ij}^{(k+1)} K(x_i, C_j^{(k+1)})} \tag{8}$$

***Step* 5 (Terminational condition)** : The cluster center is updated simultaneously with the *U* matrix. As in traditional FCM, KIFCM optimizes the objective function by continuously updating the membership functions and centers of clusters until $\left\| U^{(k+1)} - U^{(k)} \right\|$ is less than the threshold δ.

A numerical example is examined in the section for comparison of various clustering algorithms. In numerical example, the study generated 10 random points for *Cluster* 1 and 50 random points for C*luster* 2. The *Cluster* 1 multivariate normal distribution with mean vector was [1 5], and the covariance matrix sigma was $\begin{bmatrix} 1.500 & 0.866 \\ 0.866 & 2.500 \end{bmatrix}$. The *Cluster* 2 multivariate normal distribution with mean vector was [5 3], and the covariance matrix sigma was identical to that of *Cluster* 1. Figure 2(a) shows the original random data points of example. The remainder of Figure 2 displays the cluster results of KM, FCM, and KIFCM with the cluster centers displayed in Figure 2. Figure 2 also labels key data points by the red cycle in example. Table 2 shows the comparison of the accurate rate and center points of KM, FCM, and KIFCM. KIFCM obtain the best accurate rates which is equal to 1. The KIFCM algorithms could correctly class the data set. The cluster centers C_1 and C_2 of KIFCM algorithm can be searched lower and more right than traditional KM and FCM. These phenomena may be evidence that the results of example can obtain better performance when using kernel functions and IFs techniques.

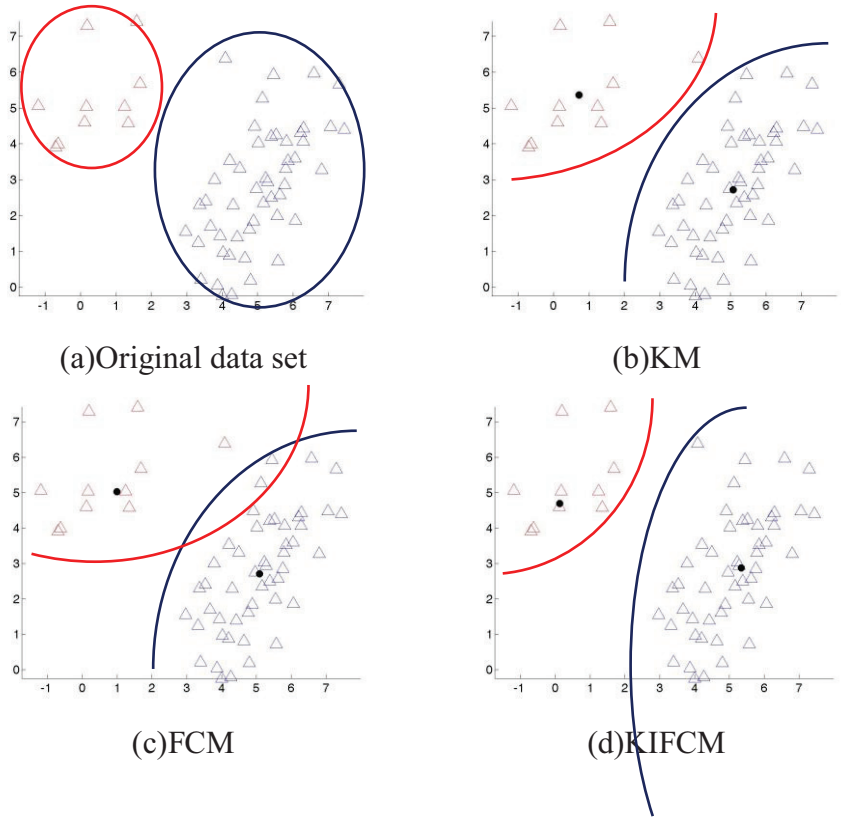


Figure 2. Illustration of the original data set and results of examplewith various clustering algorithms.

Table 3. Comparison of various clustering algorithms in synthesis data set.

Method	Parameters	Accuracy rate (J_1)	Center points
KM	c=2	0.98	C_1=(0.71, 5.36), C_2=(5.06, 2.71)
FCM	c=2, m=2	0.98	C_1=(0.98, 5.03), C_2=(5.09, 2.70)
KIFCM	c=2, m=2.33, σ=165.76,α= 4.95	1.00	C_1=(0.12, 4.68), C_2=(5.33, 2.87)

2. Rough set theory for rule generation with KIFCM clustering

Rough set theoryis a mathematical approach for handling vagueness and uncertainty in data analysis. Rough sets aim at forming an approximate definition for a target set in terms of some definable sets, especially, when the target set is uncertain or imprecise. A rough set is

characterized by a pair of precise concepts, called lower and upper approximations, generated using object indiscernibilities. Some basic concepts in the rough set theory can be found in Pawlak (1982) and Pawlak (1991). In RST, the most important problems are the reduction of attributes and the generation of decision rules. In rough set theory of rule generation, principal task is to compute reducts relative to a particular kind of information system. Instead the lower and upper approximations of all decision concepts are computed and rules are induced. The rules are categorized into certain and approximate (possible) rules depending on the lower and upper approximations, respectively. This RST of rule generation can be described below.

Let $E=<U, A>$ be a decision table with F and $D=\{d_1, d_2, \ldots, d_l\}$ its sets of condition and decision attributes respectively, where U is a nonempty finite set called the universe and A is a nonempty finite set of attributes. An attribute a can be regarded as a function from domain U to some value set V_a. Divided the decision table $E = <U, A>$ into l tables $E_i = <U_i, A_i>$, $i=1, \ldots, l$, corresponding to the l decision attributes $d_1, \ldots, d_l$, where $U = U_1 \cup \ldots \cup U_l$ and $A_i = F \cup \{d_i\}$ where $d \notin F$ is the decision variable D.

Let $\{x_{i1}, \ldots, x_{ij}\}$ be the set of those objects of U_i that occur in E_i, $i=1, \ldots, l$, and in this research the set, which can be defined $X_c = \{x_{ci1}, \ldots, x_{cij}\}$, has been divided c clusters by novel KIFCM. Based on results of KIFCM, the same group objects of X_c have similar characters which can effectively assistance rule generation of RST.

***Step* 1. (Determining indiscernibility relation)** Let $a \in A$, $P \subseteq A$. A binary relation I_P, which can be called the indiscernibility relation, can be defined as following:
$I_P = \{(x, y) \in U$: for every $a \in P$, $a(x) = a(y)\}$.
Then, $I_P = \cap_{a \in P} I_a$. If $X_c \subseteq U$, the set $\{x \in U: [x]_P \subseteq X_c\}$ and $\{x \in U: [x]_P \cap X_c \neq \varnothing\}$, where $[x]_P$ denotes the equivalence class of the object $x \in U$ relative to I_P, are called *P-lower* and *P-upper* approximation of X_c in E and denote by $\underline{I}X_c$ and $\overline{I}X_c$ respectively. If X_c is *P-definable* then $\underline{I}X_c = \overline{I}X_c$; otherwise X_c is *P-rough*.

Example I: Consider the university of discourse $U = \{x_{c1}, x_{c2}, x_{c3}, x_{c4}, x_{c5}, x_{c6}\}$ and I is any equivalence relation in I_P which partitions U into $\{\{x_{c1}, x_{c2}, x_{c4}\}, \{x_{c3}, x_{c6}\}, \{x_{c5}\}\}$. The for any subset $X_c = \{x_{c1}, x_{c2}, x_{c3}, x_{c4}\}$ of U, $\underline{I}X_c = \{x_{c1}, x_{c2}, x_{c4}\}$ and $\overline{I}X_c = \{x_{c1}, x_{c2}, x_{c3}, x_{c4}, x_{c6}\}$. Figure

3 displays the lower and upper approximations of set X_c.

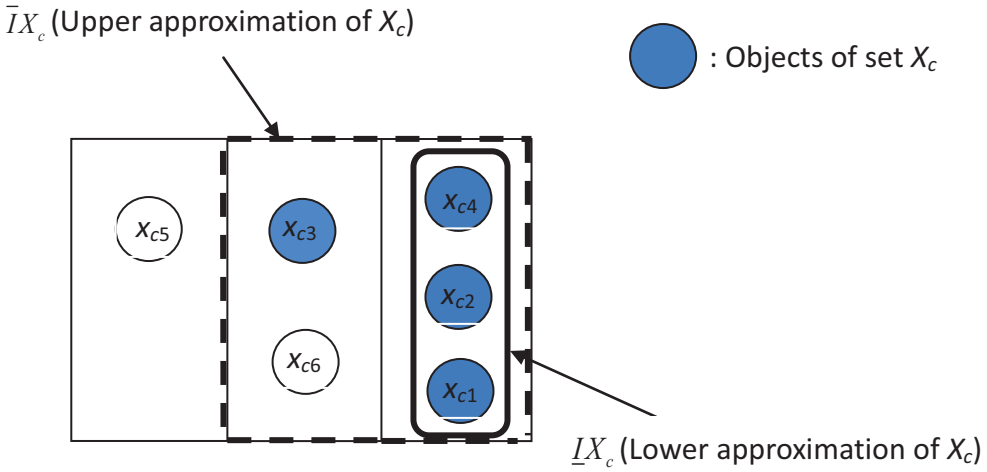


Figure 3 Illustration of the lower and upper approximations of set X_c. (Pawlak et al., 1995)

The *P-positive* region of X_c can be defined $\{x_{c1}, x_{c2}, x_{c4}\}$ and the *P-negative* region of X_c can be defined $\{x_{c5}\}$. On the other hand, consider a subset $Y_c = \{x_{c3}, x_{c5}, x_{c6}\}$, $\underline{I}Y_c = \{x_{c3}, x_{c5}, x_{c6}\}$ and $\bar{I}Y_c = \{x_{c3}, x_{c5}, x_{c6}\}$. The $\underline{I}Y_c = \bar{I}Y_c$, hence Y_c can be defined as *P-definable*.

***Step* 2. (Dispensable and indispensable attributes)** Let $f \in F$. A attribute f is dispensable in E, if $POS_{(F-(f))}(D) = POS_F(D)$; otherwise attribute f is indispensable in E. Where $POS_F(D)$ is $\bigcup_{X_c \in I_{d_i}} \underline{F}X_c$ and $\underline{F}X_c$ is the lower approximation. If all $f \in F$ are indispensable, f is an independent.

***Step* 3. (*Reduct* and *CORE*)** A *reduct* is the minimal attribute subset preserving the condition. If the E is independent and $POS_i(D)$, a set of attributes $I \subseteq F$ can be called a *reduct* of F. $CORE(F)$ can be defined the set of all attributes indispensable in F.

***Step* 4. (Discernibility matrix)** Now for each $reductP = \{p_1, \ldots, p_k\}$, a discernibility matrix $M_{d_i}(P)$ can be defined as follows (Banerjee et al., 1998):

$$f_{ij} = \{a \in P: a(x_{ci}) \neq a(x_{cj})\}, \qquad (9) \qquad \text{for } i, j = 1, \ldots, n.$$

For each object $x_{cj} \in x_{ci1}, \ldots, x_{cib}$, the discernibility function $k_{d_i}^{x_{cj}}$ can be defined as following:

$$k_{d_i}^{x_{cj}} = \bigcap \{ \bigcup (f_{ij}) : 1 \le i \ j, \le n \ j, < i \ f_{ij} \neq \varnothing \} \qquad (10)$$

Where $\bigcup(f_{ij})$ is the disjunction of all members of c_{ij}. Then $k_{d_i}^{x_{cj}}$ is brought to its conjunctive norm form (c.n.f).

Example II (Ganesan et al., 2007) Consider the knowledge representation system given $F = \{a, b, c, d\}$ and $D = \{E\}$ which are condition and decision attributes respectively, and based on KIFCM the clustering results of objects $\{\{x_{11}, x_{12}, x_{13}, x_{14}\}, \{x_{25}, x_{26}, x_{27}\}\}$ can be obtained. The discernibility matrix can be shown as Figure 4.

	a	b	c	d	E
x_{11}	1	0	2	1	1
x_{12}	1	0	2	0	1
x_{13}	1	2	0	0	2
x_{14}	1	2	2	1	0
x_{25}	2	1	0	0	2
x_{26}	2	1	1	0	2
x_{27}	2	1	2	1	1

Group 1 Group 2

	x_{11}	x_{12}	x_{13}
x_{12}	—		
x_{13}	b, c, d	b, c	
x_{14}	b	b, d	c, d

	x_{25}	x_{26}
x_{26}	—	
x_{27}	c, d	c, d

Figure 4. Illustration of the discernibility matrix based on clustering technique KIFCM.

Here, the elements of discernibility matrix can be shown in "OR" which means the element $\{b, c, d\}$ can be shown $b \vee c \vee d$. Further, the entire matrix can be written by using the connective AND.

Two-stage model for e-learning data set

In this section a real dataset of enterprise was examined. The customer data set of e-learning comes from one of famous enterprise in Taiwan. Figure 5 displays the process of real information platform with novel two-stage model in E-learning enterprise. Six conditional attributes 'Sex', 'Age', 'Academic', 'Department', 'Location', and 'Occupation' were selected, and number of instances are 669. The all conditional attributes has been coded by valued for effective executing generation rules which can see in Table 7, for instance, minimum of 'Academic' is '2' which means 'National Tsing Hua University'. Table 4 shows the dataset extensively included various instances. Decision attributes can be divided six categories which are 'Civil service examinations', 'Matriculation examinations', 'Tying examinations', 'Certification examinations', 'Learning lifelong', and 'employment examinations' respectively. These determines of categories were based on database of E-learning enterprise.

Table 5 displays the measuring indexes of the KM+RST, FCM+RST and KIFCM+RST models with different *Cluster* values in E-learning dataset. The results show that the KIFCM+RST model with c=3 can derive higher comprehensive index values of 0.71 in E-learning dataset. From the sensitivity analysis provided Table 5, the KIFCM+RST model alsoagain demonstrates good, stable performance. Therefore, KIFCM+RST model can also be recommended as an alternative rule generation model in the E-learning dataset.

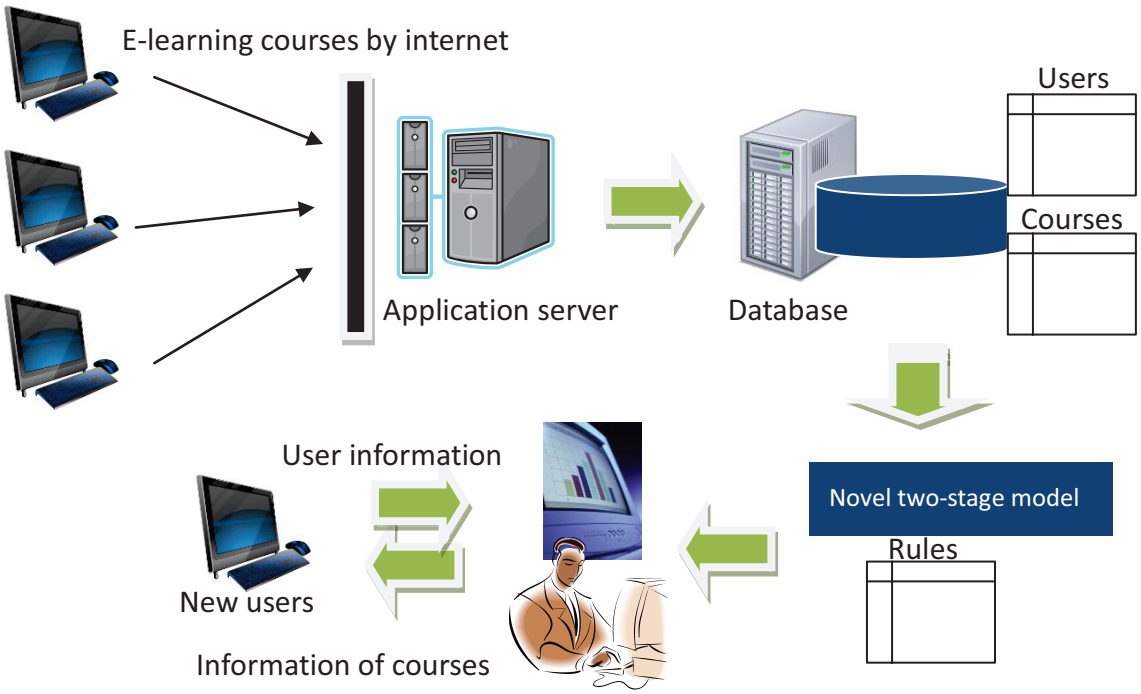


Figure 5. The process of real information platform with novel two-stage model in E-learning enterprise.

Table 4. Summary statistics and information of attributes with E-learning data sets.

Title	NO. of instances	Predictive attributes	Attributes Statistics				NO. of class
			Minimum	Maximum	Mean	Standard deviation	
E-learning	669	Sex	1: Male 2:Female				6
		Age	11	50	32.2	5.81	
		Academic	2	190	47.91	35.63	
		Department	1	178	99.31	49.81	
		Location	100	932	488.44	267.59	
		Occupation	1:Student, 2:Nonstudent				

Table 5. Testing measuring indexes of the KM+RST, FCM+RST and KIFCM+RST models with

different *Cluster* values in E-learning dataset.

Date set	Method		Accuracy rate (J_1)	Cover rate (J_2)	Comprehensive index (J)	Average of comprehensive index	No. of rules	CPU time (Minute)
	The 1st stage (KM, FCM, and KIFCM)+ The 2nd stage (Rough set)							
E-learning	KM	c=2	0.15	0.09	0.24	0.31	487	25.95
		c=3	0.18	0.20	0.38		486	21.68
		c=4	0.12	0.21	0.33		482	22.23
	FCM	c=2, m=2	0.16	0.10	0.26	0.31	487	27.85
		c=3, m=2	0.16	0.14	0.30		487	27.85
		c=4, m=2	0.18	0.21	0.39		483	24.05
	KIFCM	c=2, m=2, σ=150,α=11	0.33	0.31	0.64	0.68	519	45.29
		c=3, m=2, σ=150,α=11	0.33	0.38	0.71		522	54.40
		c=4, m=2, σ=150,α=11	0.32	0.38	0.70		535	111.59

Table 6 also shows the performances of the three models in the E-learning dataset. Proposed novel two-stage model can be proved has better performance than ID3 and standard RST with measuring indexes in the E-learning dataset. As results of Machine learning datasets proposed two-stage forecasting outperformed the other models in E-learning dataset, and the preprocess clustering mechanism (KIFCM) can effectively promote performance of RST.

Table 6. Comparison of the testing measuring indexes with various methods in E-learning dataset.

Date set	Method	Accuracy (J_1)	Cover rate (J_2)	Comprehensive index (J)	No. of rules	CPU time (Minute)
E-learning	ID3	0.14	0.17	0.31	104	1.65
	Rough set	0.16	0.19	0.35	486	27.51
	Two-stage model	0.33	0.38	0.71	522	90.98

CONCLUSIONS

This study developed a novel two-stage model for promoting the effect of rule generation based on rough set. The real e-learning customer dataset in Taiwan was examined. This real case can evidence the novel two-stage model can actually apply to real information platform. The success of the novel two-stage model can be attributed to the fact that the novel fuzzy clustering technology can effectively improve performance. Future studies may consider using various data preprocessing techniques to improve the performance of the proposed model.

ACKNOWLEDGEMENTS

The authors would like to thank the National Science Council of the Republic of China for financially supporting this research under Contract No. NSC 100-2410-H-262-002-MY2.

REFERENCES

1. Asuncion, A., and Newman, D.J. (2007), UCI Machine Learning Repository, University of California, School of Information and Computer Science, Irvine, CA, (Online) Available: (http://archive.ics.uci.edu/beta/).
2. Atanassov, K.T. (1986), “Intuitionistic fuzzy sets,” *Fuzzy Sets and Systems*, Nol. 20, pp. 87–96.
3. Atanassov, K.T. (1989), “More on intuitionistic fuzzy sets,” *Fuzzy Sets and Systems*, vol. 33, pp. 37–46.
4. Atanassov, K.T. (1999), Intuitionistic Fuzzy Sets: Theory and Applications, Heidelberg: Physica-Verlag.
5. Beynon, M., Curry, B., and Morgan, P. (2000), “Classification and rule induction using rough set theory”, *Expert System*, Vol. 17, pp. 136–147.
6. Bezdek, J.C. (1981), Pattern Recognition with Fuzzy Objective Function Algorithms, Plenum

Press, New York.

7. Burillo, P., and Bustince, H. (1996), "Vague sets are intuitionistic fuzzy sets," *Fuzzy Sets and Systems*, Vol. 79, pp. 403–405.
8. Chen, S.M. (1996), "Forecasting enrollments based on fuzzy time series", Fuzzy Sets and Systems, Vol. 81, pp. 311–319.
9. Fan, Y.-N., Tseng, T.-L., Chern, C.-C., and Huang, C.-C. (2009), "Rule induction based on an incremental rough set", Expert Systems with Applications, Vol. 36, pp. 11439–11450.
10. Fisher, R.A. (1936), "The use of multiple measurements in taxonomic problems," *Annual Eugenics*, Vol. 7 Part II, pp. 179–188.
11. Fu, L.M. (1993), "Knowledge-based connectionism for revising domain theories", *IEEE Transaction on System, Man, and Cybernetics*, Vol. 7, pp. 173–182.
12. Ganesan, G., Latha, D., and Raghavendra Rao C. (2007), "Reduct generation in information systems", *Engineering Letters*, Vol. 14, pp. EL_14_2_5.
13. Graves, D., and Pedrycz, W. (2010), "Kernel-based fuzzy clustering and fuzzy clustering: A comparative experimental study," *Fuzzy Sets and Systems*, Vol. 161, pp. 522–543.
14. Grzymala-Busse, J.W. (1992), "LERS—a system for learning from examples based on rough sets, Intelligent Decision Support," in Slowinski, R. (Ed.), *Handbook of Applications and Advances of the Rough Sets Theory*, Kluwer, Dordrecht, Boston, London, pp. 3–18.
15. Haberman, S.J. (1976), "Generalized Residuals for Log-Linear Models," *Proceedings of the 9th International Biometrics Conference*, Boston, pp. 104–122.
16. Honda, K., and Ichihashi, H. (2004), "Linear fuzzy clustering techniques with missing values and their application to local principal component analysis", *IEEE Transaction on Fuzzy Systems*, Vol. 12, pp. 183–193.
17. Hong, T.-P., Wang T.-T., and Wang, S.-L. (2007), "Mining fuzzy β-certain and β-possible rules from quantitative data based on the variable precision rough-set model", *Expert Systems with Applications*, Vol. 32, pp. 223–232.
18. Hou, T.-H., and Huang, C.-C. (2004), "Application of fuzzy logic and variable precision rough set approach in a remote monitoring manufacturing process for diagnosis rule induction", *Journal of Intelligent Manufacturing*, Vol. 15, pp. 395–408.
19. Huang, C.C., Tseng, T.L., Fan, Y.N., Hsu, C.H. (2013), "Alternative rule induction methods based on incremental object using rough set theory", *Applied Soft Computing*, Vol. 13, pp. 372–389.
20. Inuiguchi, M., and Miyajima, T. (2007), "Rough set based rule induction from two decision tables", *European Journal of Operational Research*, Vol. 181, pp. 1540–1553.

21. Kohonen, T. (1997), Self-Organizing Maps, second ed. Springer-Verlag, Berlin.
22. Liu, H., and Tan, S.T. (1995), "X2R: A fast rule generator", *Proceedings of 1995 IEEE International Conference on Systems, Man, and Cybernetics,* Vancouver, British Columbia, Canada, pp. 215–220.
23. Liu, X., and Wang, L. (2007), "Computing the maximum similarity bi-clusters of gene expression data", *Bioinformatics*, Vol. 23, pp. 50–56.
24. Luo, H.C., and Zhong, Y.B. (2010), "Application and design of MEDS based on rough set data mining rule", *Fuzzy Information and Engineering*, Vol. AISC 78, pp. 683–692.
25. Ma, T., Leong, J., Cui, M., and Tian, W. (2009), "Inducing positive and negative rules based on rough set", *Information technology Journal*, Vol. 8, pp. 1039–1043.
26. Othman, M.L., Aris, I., Othman, M.R., and Osman, H. (2011), "Rough-Set-and-Genetic-Algorithm based data mining and Rule Quality Measure to hypothesize distance protective relay operation characteristics from relay event report", *Electrical Power and Energy Systems*, Vol. 33, pp. 1437–1456.
27. Pal, S.K., Mitra, S., and Mitra, P. (2003), "Rough-fuzzy MLP: Modular evolution rule generation, and evaluation", *IEEE Transaction on Knowledge and Data Engineering*, Vol. 15, pp. 14–25.
28. Pattaraintakorn, P., Cercone, N., and Naruedomkul, K. (2006), "Rule learning: Ordinal prediction based on rough sets and soft-computing ", Applied Mathematics Letters, Vol. 19, pp. 1300–1307.
29. Pawlak, Z. (1982), "Rough sets", *International Journal of Information Computer Science*, Vol. 11, pp. 341–356.
30. Pawlak, Z. (1991), Rough sets: Theoretical Aspects of Reasoning about Data, Kluwer Academic Publishers, Dordrecht.
31. Pawlak, Z., Grzymala-Busse, J., Slowinski, R., and Ziarko, W. (1995), "Rough sets", *Communications of the ACM*, Vol. 38, pp. 89–95.
32. Pham, D.T., and Aksoy, M.S. (1995), "A new algorithm for inductive learning", *Journal of Systems Engineering*, Vol. 5, pp. 115–122.
33. Shen, H., Yang, J., Wang, S., and Liu, X. (2006), "Attribute weighted Mercer kernel based fuzzy clustering algorithm for general non-spherical datasets," *Soft Computing*, Vol. 10, pp. 1061–1073.
34. Teoh, H.J., Cheng, C.-H., Chu, H.-H., and Chen, J.-S. (2008), "Fuzzy time series model based on probabilistic approach and rough set rule induction for empirical research in stock market", *Data & Knowledge Engineering*, Vol. 67, pp. 103–117.

35. Tseng, T.-L., Kwon, Y., and Ertekin, Y.M. (2005), "Feature-based rule induction in machining operation using rough set theory for quality assurance", *Robotics and Computer-Integrated Manufacturing*, Vol. 21, pp. 559–567.
36. Qian, Y., Liang, J., and Dang, C. (2008), "Converse approximation and rule extraction from decision tables in rough set theory", *Computers and mathematics with Applications*, Vol. 55, pp. 1754–1765.
37. Quinlan, J.R. (1986), "Induction of Decision Trees",*Machine Learning*, Vol. 1, pp. 81–106.
38. Quinlan, J.R. (1993), C4.5: Programs for Machine Learning, Morgan Kaufmann Publishers, Inc., San Mateo, Calif.
39. Shi, F., Sun, S., Xu, J. (2012), "Employing rough sets and association rule mining in KANSEI knowledge extraction", *Information Sciences*, Vol. 196, pp. 118–128.
40. Towell, G.G., and Shavlik, J.W. (1993), "Extracting refined rules from knowledge-based neural networks", *Machine Learning*, Vol. 13, pp. 71–101.
41. Wang, X., Yang, J., Jensen, R., Liu, X. (2006), "Rough set feature selection and rule induction for prediction of malignancy degree in brain glioma", *Computer Methods and Programs in Biomedicine*, Vol. 83, pp. 147–156.
42. Yang, M.S. (1993), "A survey of fuzzy clustering", *Mathematical and Computer Modelling*, Vol. 18, pp. 1–16.
43. Yu, H.K. (2005), "Weighted fuzzy time series models for TAIEX forecasting", *Physica A*, Vol. 349, pp. 609–624.
44. Zadeh, L.A. (1965), "Fuzzy sets," *Information and Control*, Vol. 8, pp. 338–353.
45. Zhang, D.Q., and Chen, S.C. (2003), "Clustering incomplete data using kernel-based fuzzy C-means algorithm," *Neural Processing Letters*, Vol. 18, pp. 155–162.
46. Ziarko, W. (1993a), "Variable precision rough set model", *Journal of Computer and System Sciences*, Vol. 46, pp. 36–59.
47. Ziarko, W. (1993b), "Analysis of uncertain information in the framework of variable precision rough sets", *Foundations of Computing Decision Sciences*, Vol. 18, pp. 381–396.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

FORECASTING MODEL FOR THE INTERNATIONAL TOURISM DEMAND IN TAIWAN

Thanh-Lam Nguyen, Graduate Institute of Mechanical and Precision Engineering
National Kaohsiung University of Applied Sciences, Kaohsiung 80778, Taiwan

Jui-Chan Huang, Department of Industrial Engineering and Management
National Kaohsiung University of Applied Sciences, Kaohsiung 80778, Taiwan

Chuang-Chi Chiu, Taiwan Knowledge Bank Co, Ltd.

Ming-Hung Shu, Department of Industrial Engineering and Management
National Kaohsiung University of Applied Sciences, Kaohsiung 80778, Taiwan

Wen-Ru Tsai, Department of Industrial Engineering and Management
National Kaohsiung University of Applied Sciences, Kaohsiung 80778, Taiwan

ABSTRACT

Purpose: *Tourism has been considered a complexly integrated and self-contained economic activity but it is one of the biggest industries in many countries. This paper aims at finding an accurate forecasting model in order to make the tourism industry grow stably.*
Design/methodology/approach: *However, the determinants of the international tourism demand are not fully identified; therefore, in this paper, it is strongly suggested to use Grey forecasting model which is widely used to deal mainly with the problems of uncertainty with few data points and/or poor information which is said to be "partial known, partial unknown". In order to improve the accuracy of the model, an improved & accurate forecasting model FGM is created by combining the Fourier residual modification with the traditional Grey model GM(1,1).*
Findings: *FGM(1,1) had a very low mean absolute percentage error (MAPE) of 1.5755% in the case of monthly international tourist arrival in Taiwan. And therefore, it is selected to forecast the inbound tourism demand in Taiwan for the time being.*
Originality/value: *Though many researches have been conducted in employing Grey forecasting model and Fourier residual modification, they are revisited and applied in the case of the international tourism demand in Taiwan.*

Keywords: Tourism demand, Grey forecasting, Fourier modification

INTRODUCTION

Tourism is considered an integrated and self-contained economic activity but it hasn't been supported by a strong economic theory (Lagos, 1999). Tourism is also a complex activity which includes a strong inter-relationship among different dependable sectors in the economy; such as economic, transportation, commerce, social & cultural services, political and technological changes, etc., (Lagos, 1999). It was concluded that understanding of the variables that influence the demand for international tourism could help policy-makers a lot in planning growth strategies for the tourism industry (Habibi et al, 2009).

However, there has been no standard measure to represent "international tourism demand". It was suggested that international tourism demand be measured in terms of the number of tourist arrival, tourist expenditure (tourist receipts) or the number of nights tourists spent (Witt et al, 1995; Ouerfelli, 2008). But, due to the complexity in collecting the data of tourist expenditure and the number of nights tourists spent, tourist arrival has been widely used as an appropriate indicator of international tourism demand in many researches (González & Moral, 1995; Morley, 1998; Lim and McAleer, 2001; Kulendran and Witt, 2001; Tan et al. 2002; Song and Witt, 2003; Song et al., 2003; Dritsakis, 2004; Naude & Saayman, 2005; Ouerfelli, 2008; Habibi et al, 2009). Therefore, in this study, the monthly arrival of international tourists to Taiwan is used to denote the international tourism demand in Taiwan.

Moreover, the determinants of the international tourism demand are not fully identified. As per González & Moral (1995), they could be tourism price (including the cost of travel to and the cost of living for the tourist at the destination), the price index, the income index, marketing expenditures, demographic and cultural factors, the quality-price ratio, etc., Whereas, Witt & Witt (1995) listed them as population, origin country income or private consumption, own price (including the cost of travel to and the cost of living for the tourist at the destination- same as González & Moral (1995)), substitute prices, one-off events, trend, etc., But Hsu & Wang (2008) approached with some marketing aspects which were tour prices, distribution channel of the travel agents, traveller's income. Besides, many of the determinants are neither easily measured nor collected due to their availability. This conclusion is found in different papers written by González & Moral (1995), Witt & Witt (1995), Lagos (1999), Habibi et al. (2009).

Due to the above limitations in collecting relevant data of international tourism demand in Taiwan, it is therefore suggested to use Grey forecasting approach which has been widely employed in different areas due to its ability to deal with the problems of uncertainty with few data points and/or "partial known, partial unknown" information, to predict the demand. The residuals from the conventional Grey model are then modified with Fourier series to form a new one. These two models are then compared based on their accuracy indicators and the best one is selected to forecast the international tourism demand in Taiwan.

LITERATURE REVIEW

1. Grey Model

Grey theory offers a new approach to deal mainly with the problems of uncertainty with few data points and/or poor information which is said to be "partial known, partial unknown" (Hsu & Chen, 2003; Liu, 2007). The core of the theory is the grey dynamics model which is usually called Grey model (GM). The Grey model is used to execute the short-term forecasting operation with no strict hypothesis for the distribution of the original data series (Wang et al, 2011). The general GM model has the form of GM(d,v), where d is the rank of differential equation and v is the number of variables appeared in the equation. The basic model of Grey model is GM(1,1), a first-order differential model with one input variable which has been successfully applied in many different researches. It is obtained based on the following procedure.

Step 1: Suppose an original series with n entries is $x^{(0)}$:

$$x^{(0)} = \left\{x^{(0)}(1), x^{(0)}(2), x^{(0)}(3), \ldots, x^{(0)}(k), \ldots x^{(0)}(n)\right\} \quad (1)$$

where $x^{(0)}(k)$ is the value at time k $\left(k = \overline{1,n}\right)$.

Step 2: From the original series $x^{(0)}$, a new series $x^{(1)}$ can be generated by one time accumulated generating operation (1-AGO), which is

$$x^{(1)} = \left\{x^{(1)}(1), x^{(1)}(2), x^{(1)}(3), \ldots, x^{(1)}(k), \ldots, x^{(1)}(n)\right\} \quad (2)$$

where $$x^{(1)}(k) = \sum_{j=1}^{k} x^{(0)}(j)$$

Step 3: A first-order differential equation with one variable is expressed as:

$$\frac{dx^{(1)}}{dt} + ax^{(1)} = b \quad (3)$$

where a is called developing coefficient and b is called grey input coefficient. These two coefficients can be determined by the least square method as the following:

$$[a,b]^T = \left(B^T B\right)^{-1} B^T Y \quad (4)$$

where

$$B = \begin{bmatrix} -\left(x^{(1)}(1) + x^{(1)}(2)\right)/2 & 1 \\ -\left(x^{(1)}(2) + x^{(1)}(3)\right)/2 & 1 \\ \cdots & \cdots \\ -\left(x^{(1)}(n-1) + x^{(1)}(n)\right)/2 & 1 \end{bmatrix} \qquad Y = \left[x^{(0)}(2), x^{(0)}(3), \ldots, x^{(0)}(n)\right]^T$$

Therefore, the forecasting equation for GM(1,1) is expressed as:

$$\hat{x}^{(1)}(k) = \left[x^{(0)}(1) - \frac{b}{a}\right] e^{-a(k-1)} + \frac{b}{a} \qquad \left(k = \overline{1,n}\right) \quad (5)$$

Based on the operation of one time inverse accumulated generating operation (1-IAGO), the predicted series $\hat{x}^{(0)}$ can be obtained as the following:

$$\hat{x}^{(0)} = \left\{\hat{x}^{(0)}(1), \hat{x}^{(0)}(2), \hat{x}^{(0)}(3), \ldots, \hat{x}^{(0)}(k), \ldots, \hat{x}^{(0)}(n)\right\} \quad (6)$$

where $$\begin{cases} \hat{x}^{(0)}(1) = \hat{x}^{(1)}(1) \\ \hat{x}^{(0)}(k) = \hat{x}^{(1)}(k) - \hat{x}^{(1)}(k-1) \qquad \left(k = \overline{2,n}\right) \end{cases}$$

2.Fourier Residual Modification Grey Forecasting Model

GM(1,1) model can perform better if it is modified with Fourier series (Hsu, 2003; Guo et al, 2005; Kan et al, 2010; Askari & Fetanat, 2011; Huang & Lee, 2011). The procedure to obtain the modified model (hereafter called FGM(1,1)) is as the following.

Based on the predicted series $\hat{x}^{(0)}$ obtained from the GM(1,1) model, a residual series named $\varepsilon^{(0)}$ is defined as:

$$\varepsilon^{(0)} = \left\{\varepsilon^{(0)}(2), \varepsilon^{(0)}(3), \varepsilon^{(0)}(4), \ldots, \varepsilon^{(0)}(k), \ldots, \varepsilon^{(0)}(n)\right\} \tag{7}$$

where $\varepsilon^{(0)}(k) = x^{(0)}(k) - \hat{x}^{(0)}(k) \qquad \left(k = \overline{2,n}\right)$

Expressed in Fourier series, $\varepsilon^{(0)}(k)$ is rewritten as:

$$\varepsilon^{(0)}(k) = \frac{1}{2}a_0 + \sum_{i=1}^{F}\left[a_i \cos\left(\frac{2\pi i}{n-1}k\right) + b_i \sin\left(\frac{2\pi i}{n-1}k\right)\right] \qquad \left(k = \overline{2,n}\right) \tag{8}$$

where $F = \left[(n-1)/2 - 1\right]$ called the minimum deployment frequency of Fourier series (Huang & Lee, 2011) and only take integer number (Hsu, 2003; Guo et al, 2005; Askari & Fetanat, 2011). And therefore, the residual series is rewritten as:

$$\varepsilon^{(0)} = P.C \tag{9}$$

where

$$P = \begin{bmatrix} \frac{1}{2} & \cos\left(\frac{2\pi\times1}{n-1}\times2\right) & \sin\left(\frac{2\pi\times1}{n-1}\times2\right) & \cdots & \cos\left(\frac{2\pi\times F}{n-1}\times2\right) & \sin\left(\frac{2\pi\times F}{n-1}\times2\right) \\ \frac{1}{2} & \cos\left(\frac{2\pi\times1}{n-1}\times3\right) & \sin\left(\frac{2\pi\times1}{n-1}\times3\right) & \cdots & \cos\left(\frac{2\pi\times F}{n-1}\times3\right) & \sin\left(\frac{2\pi\times F}{n-1}\times3\right) \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ \frac{1}{2} & \cos\left(\frac{2\pi\times1}{n-1}\times n\right) & \sin\left(\frac{2\pi\times1}{n-1}\times n\right) & \cdots & \cos\left(\frac{2\pi\times F}{n-1}\times n\right) & \sin\left(\frac{2\pi\times F}{n-1}\times n\right) \end{bmatrix}$$

$$C = \left[a_0, a_1, b_1, a_2, b_2, \ldots, a_F, b_F\right]^T$$

The parameters $a_0, a_1, b_1, a_2, b_2, \ldots, a_F, b_F$ are obtained by using the ordinary least squares method (OLS) which results in the equation of:

$$C = \left(P^T P\right)^{-1} P^T \left[\varepsilon^{(0)}\right]^T \tag{10}$$

Once the parameters are calculated, the predicted series residual $\hat{\varepsilon}^{(0)}$ is then easily achieved based on the following expression:

$$\hat{\varepsilon}^{(0)}(k) = \frac{1}{2}a_0 + \sum_{i=1}^{F}\left[a_i \cos\left(\frac{2\pi i}{n-1}k\right) + b_i \sin\left(\frac{2\pi i}{n-1}k\right)\right] \tag{11}$$

Therefore, based the predicted series $\hat{x}^{(0)}$ obtained from GM(1,1), the predicted series $\tilde{x}^{(0)}$ of the FGM(1,1) is determined by:

$$\tilde{x}^{(0)} = \left\{\tilde{x}^{(0)}(1), \tilde{x}^{(0)}(2), \tilde{x}^{(0)}(3), \ldots, \tilde{x}^{(0)}(k), \ldots, \tilde{x}^{(0)}(n)\right\} \tag{12}$$

where $\begin{cases} \tilde{x}^{(0)}(1) = \hat{x}^{(0)}(1) \\ \tilde{x}^{(0)}(k) = \hat{x}^{(0)}(k) + \hat{\varepsilon}^{(0)}(k) \qquad \left(k = \overline{2,n}\right) \end{cases}$

In order to evaluate the accuracy of the forecasting model, the residual error (ε) and its relative error ($\wp$) are used (Guo et al, 2005; Liang et al, 2008). ε and $\wp$ of an entry k are expressed as:

* Residual error: $\varepsilon(k) = x^{(0)}(k) - \hat{x}^{(0)}(k) \qquad \left(k = \overline{1,n}\right)$

* Relative error: $\wp_k = \left|\varepsilon(k)\right| / x^{(0)}(k) \qquad \left(k = \overline{1,n}\right)$

However, there have been some other important indexes to be considered in evaluating the model accuracy. They are:

+ The mean absolute percentage error (MAPE) (Hsu & Chen, 2003; Guo et al, 2005; Hsu & Wang, 2008; Kan et al, 2010; Chang & Liao, 2010; Askari & Fetanat, 2011; Tsaur & Kuo, 2011; Huang & Lee, 2011; Li et al, 2011) (MAPE is also known as the average relative error δ (Hua & Liang, 2009; Ma & Zhang, 2009)):

$$MAPE = \frac{1}{n}\sum_{k=1}^{n} \wp_k$$

+ The post-error ratio C (Hua & Liang, 2009; Ma & Zhang, 2009):

$$C = \frac{S_2}{S_1}$$

where: + $S_1 = \sqrt{\frac{1}{n}\sum_{k=1}^{n}\left[x^{(0)}(k) - \bar{x}\right]^2}$ *where* $\bar{x} = \frac{1}{n}\sum_{k=1}^{n} x^{(0)}(k)$

+ $S_2 = \sqrt{\frac{1}{n}\sum_{k=1}^{n}\left[\varepsilon(k) - \bar{\varepsilon}\right]^2}$ *where* $\bar{\varepsilon} = \frac{1}{n}\sum_{k=1}^{n}\varepsilon(k)$ $\varepsilon(k) = \begin{bmatrix} x^{(0)}(k) - \hat{x}^{(0)}(k) \\ x^{(0)}(k) - \tilde{x}^{(0)}(k) \end{bmatrix}$

The ratio C, in fact, is the ratio between the standard deviation of the original series and the standard deviation of the forecasting error. The smaller the C value is, the higher accuracy the model has since smaller C value results from a larger S_1 and/or a smaller S_2.

+ The small error probability P (Hua & Liang, 2009; Ma & Zhang, 2009):

$$P = p\left\{\frac{\left|\varepsilon(k) - \bar{\varepsilon}\right|}{S_1} < 0.6745\right\}$$

The higher the P value is, the higher accuracy the model has since P value indicates the probability of the ratio of the difference between the residual values of data points and the average residual value with the standard deviation of the original series smaller than 0.6745 (Ma & Zhang, 2009).

+ The forecasting accuracy ρ (Ma & Zhang, 2009): $\rho = 1 - MAPE$

Based on the above indexes, there are four grades of accuracy as stated in Table 1.

Table 1: Four grades of forecasting accuracy

Grade level	*MAPE*	*C*	*P*	ρ
I (Very good)	< 0.01	< 0.35	> 0.95	> 0.95
II (Good)	< 0.05	< 0.50	> 0.80	> 0.90
III (Qualified)	< 0.10	< 0.65	> 0.70	> 0.85
IV (Unqualified)	≥ 0.10	≥ 0.65	≤ 0.70	≤ 0.85

EMPIRICAL STUDY

The historical data of the international tourism demand in Taiwan is obtained from the monthly statistical data published on the website of Ministry of Transportation and Communication R.O.C (MOTC) from January 2001 to September 2011. The tourism demand is referred to the number of monthly arrivals of international tourists to Taiwan. There are totally 129 observations which are used to build GM(1,1) model. The GM(1,1) model is found as

$$\hat{x}^{(1)}(k) = 24073272.64e^{0.0075324(k-1)} - 23873472.64 \qquad (14)$$

The predicted series is as in the column GM(1,1) of Table 2. From the residual series of GM(1,1) model, the forecast values under FGM(1,1) is obtained as illustrated in column FGM(1,1) of Table 2.

Table 2: Monthly Forecasted value with GM(1,1) and FGM(1,1)

MONTH	ARRIVALS	GM(1,1)	FGM(1,1)	MONTH	ARRIVALS	GM(1,1)	FGM(1,1)
Jan-01	199800	199800	199800	Jun-06	305127	294760	300888
Feb-01	234386	182014	230147	Jul-06	270850	296988	275089
Mar-01	251111	183390	255349	Aug-06	292561	299234	288323
Apr-01	235251	184777	231012	Sep-06	274118	301496	278357
May-01	227021	186174	231259	Oct-06	301575	303776	297337
Jun-01	239878	187582	235639	Nov-06	318663	306073	322901
Jul-01	218673	189000	222911	Dec-06	323931	308387	319692
Aug-01	224208	190429	219969	Jan-07	274198	310719	278437
Sep-01	193254	191869	197492	Feb-07	261799	313068	257561
Oct-01	192452	193319	188214	Mar-07	345295	315435	349533
Nov-01	190500	194781	194739	Apr-07	316119	317820	311881
Dec-01	210603	196254	206364	May-07	294021	320223	298260
Jan-02	217600	197738	221838	Jun-07	320676	322644	316438
Feb-02	233896	199233	229657	Jul-07	285075	325084	289314
Mar-02	281522	200739	285760	Aug-07	308481	327541	304243
Apr-02	245759	202257	241520	Sep-07	295594	330018	299833
May-02	243941	203786	248179	Oct-07	314519	332513	310281
Jun-02	241378	205327	237139	Nov-07	336370	335027	340608
Jul-02	234596	206879	238834	Dec-07	363916	337560	359677
Aug-02	246079	208444	241840	Jan-08	297442	340113	301681
Sep-02	233613	210020	237851	Feb-08	315134	342684	310896
Oct-02	258360	211608	254121	Mar-08	342062	345275	346300
Nov-02	255645	213207	259883	Apr-08	302819	347886	298581
Dec-02	285303	214820	281064	May-08	314700	350516	318939
Jan-03	238031	216444	242269	Jun-08	340454	353166	336216
Feb-03	259966	218080	255727	Jul-08	307287	355837	311526
Mar-03	258128	219729	262366	Aug-08	311587	358527	307349
Apr-03	110640	221390	106402	Sep-08	307402	361238	311641
May-03	40256	223064	44495	Oct-08	327038	363969	322800
Jun-03	57131	224751	52893	Nov-08	327224	366721	331463
Jul-03	154174	226450	158413	Dec-08	352038	369494	347800

Table 2: Monthly Forecasted value with GM(1,1) and FGM(1,1) (continued)

MONTH	ARRIVALS	GM(1,1)	FGM(1,1)
Aug-03	200614	228162	196376
Sep-03	218594	229888	222833
Oct-03	223552	231626	219314
Nov-03	241349	233377	245587
Dec-03	245682	235142	241443
Jan-04	212854	236919	217093
Feb-04	221020	238711	216782
Mar-04	239575	240516	243813
Apr-04	229061	242334	224823
May-04	232293	244166	236532
Jun-04	258861	246012	254622
Jul-04	243396	247873	247635
Aug-04	253544	249747	249306
Sep-04	245915	251635	250154
Oct-04	266590	253538	262351
Nov-04	270553	255454	274791
Dec-04	276680	257386	272441
Jan-05	244252	259332	248491
Feb-05	257340	261293	253102
Mar-05	298282	263268	302520
Apr-05	269513	265259	265274
May-05	284049	267265	288287
Jun-05	293044	269285	288805
Jul-05	268269	271321	272507
Aug-05	281693	273373	277454
Sep-05	270700	275440	274939
Oct-05	297454	277522	293215
Nov-05	302277	279621	306515
Dec-05	311245	281735	307006
Jan-06	264347	283865	268586
Feb-06	286156	286011	281918
Mar-06	309381	288174	313619
Apr-06	290043	290353	285805
May-06	283075	292548	287314
Jan-09	276896	372287	281135
Feb-09	303302	375102	299064
Mar-09	395201	377938	399439
Apr-09	448486	380796	444247
May-09	366375	383675	370614
Jun-09	321383	386576	317145
Jul-09	346718	389499	350957
Aug-09	367491	392444	363253
Sep-09	340645	395411	344884
Oct-09	368212	398401	363974
Nov-09	410489	401413	414727
Dec-09	449806	404448	445567
Jan-10	345981	407506	350220
Feb-10	387143	410587	382905
Mar-10	516512	413691	520750
Apr-10	506400	416819	502161
May-10	505856	419971	510094
Jun-10	470447	423146	466208
Jul-10	427763	426345	432001
Aug-10	442235	429569	437996
Sep-10	419389	432817	423628
Oct-10	485959	436089	481720
Nov-10	528998	439387	533236
Dec-10	530594	442709	526355
Jan-11	400617	446056	404856
Feb-11	453468	449428	449230
Mar-11	518215	452827	522453
Apr-11	550158	456250	545919
May-11	470471	459700	474709
Jun-11	462640	463176	458402
Jul-11	465656	466678	469894
Aug-11	506898	470206	502659
Sep-11	460994	473761	465233

Table 3 briefly demonstrates the evaluation indexes of each model with its power in forecasting the international tourism demand in Taiwan.

Table 3: Summary of evaluation indexes of model accuracy

Index / Model	MAPE	S1	S2	C	P	ρ	Forecasting power
GM(1,1)	0.160251	94388.05	44932.53	0.47604	0.87	0.839749	***Unqualified***
FGM(1,1)	0.015755	94388.05	4222.04	0.04473	1.00	0.984245	***Excellent***

From Table 3, with the low MAPE value of 1.5755%, it can be concluded that the FGM(1,1) outperforms GM(1,1). Therefore, it is strongly suggested to forecast the international tourism demand in Taiwan.

CONCLUSION

Combining the Fourier residual modification to the traditional Grey forecasting model GM(1,1) results in a highly accurate forecasting model named FGM(1,1). Particularly, in the case of the international tourism demand in Taiwan, despite of the hard assessment of relevant data about its determinants, FGM(1,1) has proved to follow closely and well fit the actual figures with the very low value of MAPE. Highly precise forecasting result will help the policy-makers and related organizations in the tourism industry to arrange enough facilities and human resources for high seasons and also make regular maintenance and training in low seasons just for a stable growth of the industry.

REFERENCES

1. Askari, M., and Fetanat, A. (2011), "Long-term load forecasting in power system: Grey system prediction-based models", Journal of Applied Sciences, Vol. 11, pp. 3034-3038.
2. Chang, Y.W. and Liao, M.Y (2010), "A seasonal ARIMA model of tourism forecasting: The case of Taiwan", Asia Pacific journal of Tourism research, Vol. 15, pp. 215-221.
3. Dritsakis, N. (2004), "Co-integration analysis of German and British tourism demand for Greece", Tourism Management, Vol. 25, pp. 111-119.
4. González, P. and Moral, P. (1995), "An analysis of the international tourism demand in Spain", International Journal of Forecasting, Vol. 11, pp. 233-251.
5. Guo, Z., Song, X. and Ye, J. (2005), "A Verhulst model on time series error corrected for port throughput forecasting", Journal of the Eastern Asia society for Transportation studies, Vol. 6, pp. 881-891.
6. Habibi, F., Rahim, K.A., Ramchandran, S., and Chin, L. (2009), **"**Dynamic Model for International Tourism Demand for Malaysia: Panel Data Evidence", International Research Journal of Finance and Economics, Vol. 33, pp. 207-217.
7. Hsu, C.C., and Chen, C.Y. (2003), "Applications of improved grey prediction model for power demand forecasting", Energy Conversion and Management, Vol. 44, pp. 2241-2249.
8. Hsu, L.C. (2003), "Applying the grey prediction model to the global integrated circuit industry", Technological forecasting & Social change, Vol. 70, pp. 563-574.

9. Hsu, L.C., and Wang, C.H. (2008), "The development and testing of a modified Diffusion model for predicting tourism demand", International Journal of Management, Vol. 25, pp. 439-445.
10. http://www.motc.gov.tw/motchypage/en/hypage.cgi?HYPAGE=eng_stat06.asp&catid=10
11. Hua, J., and Liang, Q. (2009), "Application research of the Grey forecast in the Logistics demand forecast", First International Workshop on Education Technology and Computer Science, Vol. 3, pp. 361-363.
12. Huang, Y.L. and Lee, Y.H (2011), "Accurately forecasting model for the Stochastic Volatility data in tourism demand", Modern economy, Vol. 2, pp. 823-829.
13. Kan, M.L., Lee, Y.B. and Chen, W.C. (2010), "Apply grey prediction in the number of Tourist", in The fourth international conference on Genetic and Evolutionary computing in Shenzhen, China, 2010, pp. 481-484.
14. Kulendran, N., and Witt, S. (2001), "Co-integration versus least squares regression", Annals of Tourism Research, Vol. 28, pp. 291–311.
15. Lagos, D.G (1999), "Exploratory forecasting methodologies for tourism demand", Ekistics Journal, Vol. 396, pp. 143-154.
16. Li, G.D., Wang, C.H., Masuda, S., and Nagai, M. (2011), "A research on short term load forecasting problem applying improved grey dynamic model", Electrical power and Energy systems, Vol. 33, pp. 809-816.
17. Liang, P., Zhou, H., and Zheng, J. (2008), "Forecast research of droplet size based on Grey theory", IFIP Advances in Information and Communication Technology, Vol. 258, pp. 653-658.
18. Lim, C., and McAleer, M. (2001), "Monthly seasonal variations: Asian tourism to Australia", Annals of Tourism Research, Vol. 28, pp. 68–82.
19. Liu, S.F. (2007), "Advances in Grey system theory and its applications" in Proceedings of 2007 IEEE International Conference on Grey Systems and Intelligent Services in Nanjing, China, 2007.
20. Ma, H., and Zhang, Z. (2009), "Grey prediction with Markov-Chain for Crude oil production and consumption in China", Advances in Intelligent and Soft Computing, Vol. 56, pp. 551-561.
21. Ministry of Transportation and Communication R.O.C, Monthly Statistics, Retrieved on Dec. 2, 2011 from
22. Morley, C. L. (1998), "A dynamic international demand model", Annals of Tourism Research, Vol. 23, pp. 70-84.
23. Naude, A.W., and Saayaman, A., (2005), "Determinants of tourist arrivals in Africa: a panel data regression analysis", Tourism Economics, Vol. 11, pp. 365-391.
24. Ouerfelli, C. (2008), "Co-integration analysis of quarterly European tourism demand in Tunisia", Tourism Management, Vol. 29, pp. 127-137.
25. Song, H. and Witt, S.F. (2003), "General-to-specific modeling to international tourism demand forecasting", Journal of Travel Research, Vol. 42, pp. 65-74.
26. Song, H., Witt, S. F., and Li, G. (2003), "Modelling and forecasting the demand for Thai tourism", Tourism Economics, Vol. 9, pp. 363–387.
27. Tan, Y. F., McCahon, C., and Miller, J. (2002), "Modelling tourist flows to Indonesia and Malaysia", Journal of Travel and Tourism Marketing, Vol. 12, pp. 63–84.
28. Tsaur, R.C., and Kuo, T.C (2011), "The adaptive fuzzy time series model with an application to Taiwan's tourism demand", Expert systems with Applications, Vol. 38, pp. 9164-9171.

29. Wang, S.J., Wang, W.L, Huang, C.T., and Chen, S.C. (2011), "Improving inventory effectiveness in RFID-enabled global supply chain with Grey forecasting model", Journal of Strategic Information Systems, Vol. 20, pp. 307-322.
30. Witt, S.F., and Witt, C.A. (1995), "Forecasting tourism demand: A review of empirical research", International Journal of Forecasting, Vol. 11, pp. 447-475.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

BASIC QUATERNARY DESIGN TABLE USING GEOMETRICAL DESIGN

**Jen-der Day, Department of Industrial Engineering and Management,
National Kaohsiung University of Applied Sciences, Kaohsiung, TAIWAN.
jdd@kuas.edu.tw**

**Hsien-Tang Tsai, Department of Business Management,
National Sun Yen-sen University, Kaohsiung, TAIWAN.
htt@mail.nsysu.edu.tw**

ABSTRACT

Purpose *Taguchi provided some useful tools such as various orthogonal arrays, interaction tables, linear graphs, etc. for planning fractional factorial experiments and had many successful application cases in quality engineering (Taguchi, 1986). However, many research articles explored the methods that were used to construct those tools and tried to improve them. The aim of this article is to develop a new tool to substitute the uses of Taguchi's orthogonal arrays and interaction tables.*
Design/methodology/approach *Using a number representation system whose base is a power of 2, Tsai (1999) developed an easy algorithm for obtaining multi-factor interaction columns in geometrical designs, which serves as theoretic background for the development of a new tool.*
Finding *Based on the algorithm of base 4, in this article we propose a Basic Quaternary Design Table (BQDT) which is a 4 by 4 squared matrix with entries of both decimal and quaternary column numbers. A BQDT has a nice structure of confounding relationships so that users could identify multi-factor interaction columns in a straightforward manner without looking up tables. The advantages of the proposed BQDT include (1) it serves as an efficient tool for column assignment problem; (2) it can substitute the use of Taguchi's interaction table; (3) it is visually appealing such that the users can easily recognize some special designs.*
Originality/value *Both geometrical design matrix and the BQDT can be used jointly to plan a two-level fractional factorial experiment without looking up tables, which can substitute the uses of Taguchi's orthogonal arrays and interaction tables when run size n is a power of 2.*

Key words: Geometrical design, Quaternary, Taguchi's interaction table
Classification: Research paper
Subject Area: Quality improvement and management

INTRODUCTION

Taguchi's orthogonal arrays are useful tool for planning fractional factorial experiments and have many successful application cases in quality engineering (Taguchi, 1986). For planning an experiment, Taguchi provided some useful tools such as various orthogonal arrays (or design matrices), interaction tables, linear graphs, etc. and adopted the column assignment method in which the required factors are assigned to appropriate columns of a given orthogonal array. However, many research articles explored the methods that were used to construct those tools and tried to improve them (Bullington, et al., 1990; Kacker, et al., 1991).

The geometrical design (G_n) proposed by Plackett & Burman (1946), which is the same as a regular Hadamard matrix when the run size of n is a power of 2, can be constructed easily by using a consecutively doubling method without any computation or looking up tables; that has a practical advantage for uses and overwhelms the use of Taguchi's orthogonal arrays. Taguchi's interaction table is a n by n triangle matrix with the entries of two-factor interaction columns, where n is the number of run size of an orthogonal array. The table can be used to find multi-factor interaction columns efficiently; however, its size becomes larger as n increases so as to create a big burden for uses by looking up lager tables.

The aim of this article is to develop a new efficient tool based on geometrical designs to substitute the uses of Taguchi's orthogonal arrays and interaction tables. Using a number representation system whose base is a power of 2, Tsai (1999) developed an easy algorithm for obtaining two-factor or multi-factor interaction column in geometrical designs. Based on the results of base 4, a Basic Quaternary Design Table (BQDT) is proposed in this article for planning two-level fractional factorial experiments. The content is organized as follows: geometrical designs and the number representation algorithm for 2fi are stated first, then a BQDT is proposed and its wordlength pattern is discussed, finally some special designs using the BSDT with visually appealing are presented and discussed.

GEOMETRICAL DESIGNS

A doubling method was given by Plackett and Burman (1946, p313): If A is orthogonal,

$\mathbf{B}=\begin{bmatrix}\mathbf{A} & \mathbf{A}\\ \mathbf{A} & -\mathbf{A}\end{bmatrix}$ is also orthogonal and has double the order of A. Note that B can be expressed as $B=[A_L, A_R]$, where $A_L=[A, A]'$, $A_R=[A, -A]'$, and A_R is called "fold-over" by Box and Wilson (1951). Starting from G_2, geometrical designs (GD's) can be obtained by the successive doubling method as follows:

$$\mathbf{G}_2=\begin{bmatrix}1 & 1\\ 1 & -1\end{bmatrix},\quad \mathbf{G}_4=\begin{bmatrix}\mathbf{G}_2 & \mathbf{G}_2\\ \mathbf{G}_2 & -\mathbf{G}_2\end{bmatrix}=\begin{bmatrix}1 & 1 & 1 & 1\\ 1 & -1 & 1 & -1\\ 1 & 1 & -1 & -1\\ 1 & -1 & -1 & 1\end{bmatrix},\ \text{and}$$

$$\mathbf{G_8}=\begin{bmatrix}\mathbf{G_4} & \mathbf{G_4}\\ \mathbf{G_4} & -\mathbf{G_4}\end{bmatrix}=\begin{bmatrix}1 & 1 & 1 & 1 & 1 & 1 & 1 & 1\\ 1 & -1 & 1 & -1 & 1 & -1 & 1 & -1\\ 1 & 1 & -1 & -1 & 1 & 1 & -1 & -1\\ 1 & -1 & -1 & 1 & 1 & -1 & -1 & 1\\ 1 & 1 & 1 & 1 & -1 & -1 & -1 & -1\\ 1 & -1 & 1 & -1 & -1 & 1 & -1 & 1\\ 1 & 1 & -1 & -1 & -1 & -1 & 1 & 1\\ 1 & -1 & -1 & 1 & -1 & 1 & 1 & -1\end{bmatrix}.$$

Similarly, all geometrical designs with higher orders such as G_{16}, G_{32}, G_{64}, etc. could be obtained easily by hand writing, or by using "Excel" functions such as "copy" and "replace" without any computation. Note that a geometrical design is the same as Hadamard matrix when its run size is a power of 2.

NR ALGORITHM FOR 2FI IN GD'S

Tsai (1999) showed that the doubling method has a nice recursive property for obtaining two-factor interactions (2fi's). By observing the basic matrix of doubling $\begin{bmatrix}1 & 1\\ 1 & -1\end{bmatrix}$, the 2fi of $\begin{bmatrix}1\\1\end{bmatrix}$ and $\begin{bmatrix}1\\1\end{bmatrix}$ is $\begin{bmatrix}1\\1\end{bmatrix}$; $\begin{bmatrix}1\\-1\end{bmatrix}$ and $\begin{bmatrix}1\\-1\end{bmatrix}$ is $\begin{bmatrix}1\\1\end{bmatrix}$; $\begin{bmatrix}1\\-1\end{bmatrix}$ and $\begin{bmatrix}1\\1\end{bmatrix}$ is $\begin{bmatrix}1\\-1\end{bmatrix}$, respectively. This property is well preserved during the process of doubling. If a geometrical design is partitioned as left-half and right-half parts such as $G_{2n}=[A_L, A_R]$, where $A_L=[G_n, G_n]'$, $A_R=[G_n, -G_n]'$, then three confounding relationships can be observed as follows:

(1) The 2fi column of any two given columns in A_L remains in A_L.
(2) The 2fi column of any two given columns in A_R remains in A_L.
(3) The 2fi column of any two given columns of which one is in A_L and the other one is in A_R remains in A_R.

Namely, the basic rule for 2fi is "left by left → left"; "right by right → left"; "left by right →right", or in short A_L x A_L → A_L; A_R x A_R → A_L; A_L x A_R→ A_R. This rule can be easily extended to higher order interactions.

Based on a number representation system whose base is a power of 2, Tsai (1999) proposed an efficient method, called NR method, for obtaining the 2fi column. Let E denote the 2fi column of two given columns C and D, namely, $E=T_n(C,D)$, then the NR method for quaternary case is stated as below:
1. Convert two given column numbers C and D into digits with base 4.
2. Compute $E=T_n(C,D)$ digit by digit according to the basic confounding relationships in G_4 such as $T_4(1,2)=3$; $T_4(1,3)=2$; $T_4(2,3)=1$; $T_4(0,j)=j$; $T_4(j,j)=0$, $j=0,1,2,3$.
3. Convert the resulting digit numbers with base 4 back to a decimal digit number.

Two numerical examples are given below:

a. $T_{16}(9,14)=T_{16}([21,32])=[13]=7$;
b. $T_{128}(13,99)=T_{128}([0031],[1203])=[1232]=110$.

BASIC QUATERNARY DESIGN TABLE

Based on the above NR algorithm for the quaternary case, since its basic confounding relationship $T_4(i,j)$, i, j=0,1,2,3 is quiet straightforward and is almost memory free, we can easily construct a "Basic Quaternary Design Table (BQDT)" as in Table 1.

Table 1. A Basic Quaternary Design Table (BQDT) for G_{16}.

0 (00)	4 (10)	8 (20)	12 (30)
1 (01)	5 (11)	9 (21)	13 (31)
2 (02)	6 (12)	10 (22)	14 (32)
3 (03)	7 (13)	11 (23)	15 (33)

This is a two-level geometrical design with 16 runs, say G_{16}, in which all sixteen columns are arranged in a 4x4 square table, the entries of 0 to 15 are decimal column numbers while the entries in the parentheses are corresponding quaternary column numbers. The usefulness of this BQDT has two aspects: (1) the required factors can be assigned directly to corresponding columns to form a fractional factorial design; note that the column 0 is an identity column which cannot be assigned any factor; (2) any multi-factors interaction can be obtained naturally according to the basic confounding relationships in G_4, for example, the 2fi of column 9 (21) and column 14 (32) is column 7 (13). Therefore, applying the basic confounding relationships in G_4, we can obtain the 2fi of any two given columns in a straightforward manner without looking up any interaction table. In other words, the BQDT can substitute the use of Taguchi's interaction table in a more natural way.

WORDLENGTH PATTERN OF BQDT

Maximum resolution (Box & Hunter, 1961) and minimum aberration (Fries & Hunter, 1980) are two important criteria for choosing a good fractional factorial design, in which the wordlength patterns (WLP's) are required for comparisons. A defining relation is a word of letters (factors) denoted by 1, 2, 3…(or A, B, C…) and the number of letters in a word is called as its wordlength. A 2^{n-p} fractional factorial design d with n factors is uniquely determined by p independent defining relations (words) which generate the defining contrast subgroup. Then, the wordlength pattern of a design d is defined as the vector $WLP(d)=[A_1(d), A_2(d), \ldots, A_n(d)]$, where $A_k(d)$ is the number of length-k words in the defining contrast subgroup. In this section, we will discuss the most often used length-four and length-three words, respectively.

Assume that 15 factors are assigned to columns 1-15 in a saturated 2^{15-11} design and a BQDT (G_{16}) is used to obtain both A_3 and A_4. To facilitate the presentation, let j-th column set be denoted by C(j) = {(j,0), (j,1), (j,2), (j,3)} while i-th column set is denoted by C(i) = {(0,i), (1,i), (2,i), (3,i)}. By using combinatorial method, all four-factor interactions (4fi's) confounded with the identity column (column 0) will be identified first, and they are classified into five different categories. Note that column 0 is also assumed as one factor and is included in the analysis.

(a) Column and row: There are 8 4fi's in three column sets and three row sets, for examples, $T_4(10,11,12,13)=00$; $T_4(03,13,23,33)=00$.

(b) Pair in each of two column sets: Consider a pair factors are in each of two column sets, for example, in column sets 0 and 1, (00,01,12,13), (10,11,02,03), (00,11,02,13), (10,01,12,03), (00,11,12,03), (10,01,02,13) confounded with column 0. There are $\binom{4}{2}=6$ combinations for four column sets, and 6 4fic's are in each combination, therefore 6x6=36 4fic's are obtained in subtotal.

(c) Pair in each of two row sets: Similar to column sets above, 36 4fic's are obtained in subtotal. For example, in row sets 0 and 1, (00,10,21,31), (01,11,20,30), (00,11,20,31), (01,10,21,30), (00,11,21,30), (01,10,20,31) confounded with column 0.

(d) 2x2 Square: There are 6 2x2 square in any two column sets, for example, in column set 0 and 1, (00,01,10,11), (00,02,10,12), (00,03,10,13), (01,02,11,12), (01,03,11,13), (02,03,12,13). Thus, there are 6 combinations for four columns sets, and 6 4fic's are in each combination, therefore 6x6=36 4fic's are obtained in subtotal.

(e) Latin Square: Similar to a Latin Square, each factor can only be shown up once either in a row or a column, example, (00,11,22,33),(01,10,23,32), (02,10,21,33), etc. There are 4!=24 4fic's in a 4x4 Latin Square.

In total, there are 8+36+36+36+24=140 4fi's in a BQDT with 16 factors including column 0. If a four-factor interaction (4fi) contains the identity column (column 0) then it is a length-3 word, otherwise it is a length-4 word. By fixing column 0 in five categories, the number of length-three words is equal to A_3=2+9+9+9+6=35; while the number of length-four words is equal to A_4=6+27+27+27+18=105.

SOME SPECIAL DESIGNS

Chen, Sun and Wu (1993) provided a catalogue of two-level and three-level fractional factorial designs with small runs, the additional column numbers other than independent columns are reported and the design numbers are arranged as [k-p.i] in the given tables. Two special designs will be adopted to illustrate the use of a BQDT, and how to construct other alternative designs. For a BQDT with run size n=16, the left-half part contains columns 0-7 while the right-half part contains 8-15.

(a) Even MA Resolution IV designs

The series of $\mathbf{2_{IV}^{4-1}}$, $\mathbf{2_{IV}^{8-3}}$, $\mathbf{2_{IV}^{16-11}}$, $\mathbf{2_{IV}^{32-26}}$,... has twice as many runs (n=2k) as factors (k) and are even minimum aberration (MV) resolution IV designs, in which each of k-1 alias sets contains k/2 2fi's. Table 2 shows an example of k=8 in [8-4.1], factors are assigned to columns {1,2,4,5,8,11,13,14}, each of 7 blank columns contains 4 2fi's, and W=(0,14,0,0,0,1). Table 3 shows another similar even MA resolution design in which factors are assigned to columns 8-15 in the right-half part, each of 7 blank columns in the left-half part contains 4 2fi's, and with the same W=(0,14,0,0,0,1).

Table 2. The design of 2^{8-4} with even MA resolution IV in [8-4.1].

00	10	20	
01			31
02			32
	13	23	

Table 3. The similar design of 2^{8-4} with even MA resolution IV.

00		20	30
		21	31
		22	32
		23	33

(b) Maximal number of Clear 2fi's

In Wu and Chen (1992), any two-factor interaction (2fi) that is not aliased with any main effect or other 2fi's is called "clear". Table 4 shows that 8 factors are assigned to columns {1,2,3,4,5,6,7,8} in [8-4.6], the 2fi of any two factors in left-half part remains in left-half part; the 2fi of column 8 with any column in left-half part remains in right-half part. Obviously, seven clear 2fi's in columns 9-15 are clear. Table 5 shows that if column 8 is replaced by any one from columns 9-15 in Table 10, then the design also have seven clear 2fi's in right-half part.

Table 4. The design of 2^{8-4} with seven clear 2fi's in [8-4.6].

00	10	20	
01	11		
02	12		
03	13		

Table 5. The similar design of 2^{8-4} with seven clear 2fi's.

00	10		30
01	11		
02	12		
03	13		

Above all, Tables 2, 3, 4, and 5 show that the BQDT is visually appealing in which some special patterns and confounding relationships exist for special designs. This highlights another advantage of BQDT over the Taguchi's interaction tables.

CONCLUSIONS

A Basic Quaternary Design Table (BQDT) was proposed as a new tool for an experimenter to plan a two-level fractional factorial design, in which all required factors can be assigned directly into the corresponding columns of the table. The BQDT has a nice structure of confounding relationships so that users could identify any interaction columns in a straightforward manner without looking up tables. The length-three or length-four words of the BQDT are classified into five categories. Besides, some special designs such as even minimum aberration resolution IV or maximal clear 2fi's could be constructed easily with the

help of a BQDT. Note that one of the key advantages to the practical users is that the BQDT is visually appealing. Furthermore, the BQDT can be extended to a large case in the future research.

ACKNOWLEGEMENT

This research is supported by Chinese National Science Council Grant NSC-101-2410-H-110 -009 -MY2 to National Sun Yat-sen University.

REFERENCES

1. Box, G.E.P., and Hunter, J.S. 1961, "The 2^{k-p} fractional factorial designs, part I", Technometrics, Vol. 3 No. 3, pp. 311-351.
2. Bullington, K.E., Hool, J.E., and Maghsoodloo, S. 1990, "A simple method for obtaining resolution IV designs for use with Taguchi's orthogonal arrays", Journal of Quality Technology, Vol. 22 No. 4, pp. 260-264.
3. Chen, J., Sun, D. X., and Wu, C.F.J. 1993, "A catalogue of two-level and three-level fractional designs with small runs", International Statistical Review, Vol. 61 No. 1, pp. 131-145.
4. Fries, A., and Hunter, W.G. 1980, "Minimum aberration 2^{k-p} designs", Technometrics, Vol. 22 No. 4, pp. 601-608.
5. Kacker, R.N., Lagergren, E.S., and Filliben, J.J. 1991, "Taguchi's fixed-element arrays are fractional factorials", Journal of Quality Technology, Vol. 23 No. 2, pp. 107-116.
6. Plackett, R.L. and Burman, J.P. 1946, "The design of multifactorial experiments", Biometrika, Vol. 33, pp. 305-325.
7. Taguchi, G. 1986, Introduction to quality engineering, Asian Productivity Organization, Tokyo.
8. Tsai, H.T. 1999, "Number representation method for obtaining two-factor interaction columns in two-level orthogonal arrays", International Journal of Quality & Reliability Management, Vol. 16 No. 6, pp. 552-561.
9. Wu, C.F.J., and Chen, Y.Y. 1992, "A graph-aided method for planning two-level experiments when certain interactions are important", Technometrics, Vol. 34 No. 2, pp. 162-175.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

SCENARIO PREDICTION OF JAPANESE SOFTWARE INDUSTRY THROUGH HYBRID METHOD

Yasuo Kadono, Tokyo University of Technology, Japan
kadono@media.teu.ac.jp

ABSTRACT

This paper aims at considering the possibility of the future scenario predictions of Japanese software industry through hybrid method. Thus, we try to preliminarily develop a new research framework by connecting the data obtained by large-scale fact-finding investigations, the statistical analyses results using the dynamic modeling, and the future scenarios of Japanese software industry through the simulation. First, we designed a large-scale social survey of the enterprise software industry in Japan, administered it, and developed a measurement tool of the software engineering capabilities with Ministry of Economy, Trade and Industry (METI). Second, we empirically verified that the human resource development of the IT firms improves the operational software engineering capabilities, and that the enhancement of the software engineering capabilities tends to improve the business performance of the IT firms in long term using the dynamic modeling. Third, we are trying to visualize the future scenario of Japanese software industry through the agent-based simulation.

This research includes the following original characteristics of academic research and expected results. First, the research suggests the guideline of the global technological strategy for Japan's software industry to ensure sustainable competitive advantage through the connection among large-scale social surveys, statistical analyses, and future prospects. Second, the research is a challenge for evidence-based visualization of industrial growth scenario by integrating society's intellectual caliber, which has evolved individually, such as fact-finding investigation conducted with METI, management theory, statistical analyses, and social simulation models. Third, the research has a possibility of evolving of the methods of designing for management of technology as a national strategy, from the viewpoint of management of technology, such as scale of players, technology paradigm shifts, global competitions and collaborations. Fourth, the methods through the connection among large-scale social surveys, statistical analyses, and future prospects, developed in the software industry in Japan can be expanded to any other sectors in any countries.

Keywords: software industry, innovation, social survey, statistical analysis, agent-based modeling

INTRODUCTION

Many companies in Japan that use enterprise software have not been fully satisfied with the quality, cost, and productivity of software that IT vendors deliver, or the speed of delivery. At the same time, IT vendors in Japan are facing drastic changes in their business environment, such as technological innovations and new entrants from emerging countries, e.g., China and India. Also, there are particular issues that are present in the IT industry in Japan, such as vendors relying on multilayer subcontractors and legacy business models that depend on

supplying custom-made applications for the domestic market. In fact, in 2009, the information service industry was a 10.5 trillion yen market in Japan, of which 7.6 trillion yen was for software development and programming. In 2009, orders for software totaled 6.4 trillion yen, accounting for 60.3% of the entire information service industry, while the software products market was 1.2 trillion yen (METI, 2010).

In order to meet these challenges in Japanese software industry, this paper aims at considering the possibility of the future scenario predictions of Japanese software industry through hybrid method by connecting large-scale social surveys, statistical analyses using the dynamic modeling, and the future scenarios of Japanese software industry through the simulation. First, we designed a large-scale social survey of the enterprise software industry in Japan, administered it, and developed a measurement tool of the software engineering capabilities with Ministry of Economy, Trade and Industry (METI). Then, we empirically verified that the human resource development of the IT firms improves the operational software engineering capabilities, and that the enhancement of the software engineering capabilities tends to improve the business performance of the IT firms in long term using the dynamic modeling. Second, we try to visualize the future scenario of Japanese software industry through the agent-based simulation.Then, we preliminarily developed a new research scheme to connect large-scale social surveys, statistical analysis results, and visualizing the future scenario of Japanese software industry.

LARGE-SCALE FACT-FINDING INVESTIGATIONS ON SOFTWARE ENGINEERING CAPABILITIES IN JAPAN

In order for the IT industry in Japan to meet the challenges as mentioned above, an important step is to understand how software engineering capability as a core competence for the industry is significant for achieving medium- and long-term success. Therefore, we designed a research survey on software engineering capabilities and administered it in 2005, 2006, and 2007, in collaboration with METI and Information-Technology Promotion Agency, Japan (IPA).
The objectives of the research were to:

- assess the achievements of the software engineering discipline, as represented by IT vendors in Japan, and
- better understand the mechanisms of how software engineering capabilities relate to IT vendors' business performance and business environment.

To achieve these objectives, we developed a measurement tool called Software Engineering Excellence (SEE), which can be used to evaluate the overall software engineering capabilities of IT vendors consisting of the seven factors: Deliverables, Project Management, Quality Assurance, Process Improvement, Research and Development, Human Resource Development, and Customer Contact based on interviews with industry experts and the literature searches (Barney, 2007; Carnegie Mellon University, Software Engineering Institute; Fujimoto, 2003; IEEE, Computer Society, 2004; Porter, 1980)
.
We introduced two other indicators as well: Business Performance and Business Environment. Business Performance indicates the overall business performance of individual IT vendors, such as profitability, growth, productivity, and efficiency of the management. Business Environment expresses the company profile and structure of an IT vendor, e.g.,

origin of vendor, number of software engineers, average age of employees, business model, customer base, and corporate culture.

In the 2005 survey, there were 55 valid responses, a response rate of 24%, for the 2005 survey; and in the 2006 survey, there were 78 valid responses, a response rate of 15%. In the 2007 SEE survey, responses were received from 117 companies, with a total of 100 valid responses, a response rate of 10%. In the 2007 SEE survey, the sample size of each type of vendor, i.e., maker-turned, user-turned, and independent, was large enough to perform stratified analysis.

STATISTICAL ANALYSIS RESULTS ON RELATIONSHIPS BETWEEN SOFTWARE ENGINEERING CAPABILITIES AND BUSINESS PERFORMANCE

After collecting data from vendors in 2005, 2006, and 2007, we calculated the standardized factor loadings of the seven factors - Deliverables, Project Management, Quality Assurance, Process Improvement, Research and Development, Human Resource Development, and Customer Contact - through confirmatory factor analysis, based on the responses received to the questions relevant.

Regarding the cross-section analysis, on the basis of the data collected from 78 firms in SEE2006, we succeeded, by a trial and error method, in constructing a well-fitted path model (CFI = 1.0), where all the existing path coefficients are significant at the 5% level through the use of a atructural equation model (Bollen, 1989). We found that superior Deliverables and Business Performance correlate significantly with effort expended, particularly on Human Resource Development, Quality Assurance, Research and Development, and Process Improvement (Kadono, Tsubaki and Tsuruho, 2008).

In terms of the panel analysis results of software engineering capabilities, we integrated 233 valid responses to the SEE surveys received over three years into a single database and identified 151 unique IT firms, consisting of 42 maker-turned vendors, 33 user-turned vendors, and 76 independent vendors. Then we conducted panel analyses of the seven SEE factors, using the three years of data, to clarify what influence SEE factors have within a year, year-to-year, and mid-term. Based on the results of the panel analysis, our first observation is that most SEE factors in one year have significant positive influences on the same factors the next year. Second, within a year, there are three paths to improving the level of Deliverables, i.e., through Project Management, Quality Assurance and Research and Development. Third, some SEE factors have significant positive influence diagonally on different SEE factors in the following year. Fourth, there are some negative paths, implying that efforts put toward a particular factor do not pay off the duration of our research. Even so, these efforts might be expected to exert longer-term positive effects on other SEE factors (Kadono, 2011).

To understand the long-term relationships among the software engineering capabilities and business performance of the representative IT firms in Japan, we conducted longitudinal analyses on standardized software engineering capability scores of three surveys and ten-year business performance from 151 firms (Meredith and Tisak, 1990). Through the panel analyses, we found that IT firms maintaining high levels of deliverables, derived from high levels of human development, quality assurance, project management and process

improvement, tend to sustain high profitability, while IT firms with high levels of project management and customer contact tend to be highly productive and increasingly improve the productivity in the long-term. Concerning business performance, profitable IT firms tend to be stable and this tendency accelerates progressively due to the enhancement of deliverables and R&D. However, productive IT firms are not necessarily profitable likely because of the multi-layered industry structure in Japan (Kadono and Tsubaki, 2012).

NEW RESEARCH FRAMEWORK OF FUTURE SCENARIO PREDICTION

To consider the possibility of the future scenario predictions of Japanese software industry, we try to preliminarily develop a new research framework by connecting the data obrained by large-scale fact-finding investigations, the statistical analyses results using the dynamic modeling, and the visualization of future scenarios of Japanese software industry through the simulation.

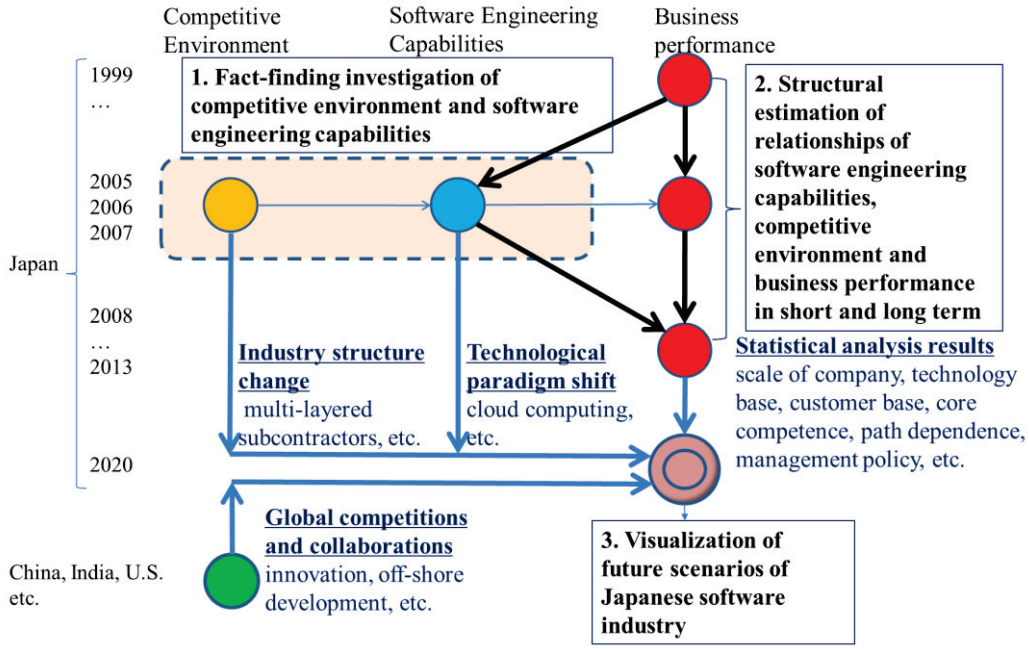


Figure 1: Connection of large-scale fact-finding investigations, statistical analyses and visualizing the future scenario of Japanese software industry

First, we try to understand the whole structure of the current Japan's enterprise software industry from the viewpoint of scale of company, path-dependency, software engineering capabilities, technological base, and customer base based on the fact-finding investigation and statistical analysis results as descrived above. Second, regarding Japan's enterprise software industry structure, we hypothesize that it is an unstable based on multi-layered industry structure consisting of large-scale system integrators, mid-sized software houses, and small temporary manpower companies. Third, the advanced technology paradigm is coming from the U.S. and other countries over the years, e.g., mainframe computer, client-server architechture, personal computer, internet, cloud computing. And Japan's enterprise software industry has fallen behind the U.S. and others. In other words, we think it predictable what advanced technology paradigm is coming next except the timing of the arrival from the

abroad. Fourth, global competitions and collaborations, such as off-shore developments in China, India, and other countries, have become active increasingly.

Then, we try to predict the future industry scenarios in 5-10 years, considering such four factors as statistical analysis results, industry structure changes, technological paradigm shifts, and global competitions and collaborations through the agent-based simulation (Epstein and Axtell, 1996). Here, we need to carefully experiment on the speed of the penetration of new technological paradigm into Japanese market, and the speed of changes of the cost structure in emerging countries as well as the improvement of communication levels between Japanese IT user companies and offshore vendors.

We preliminarily observed the tradeoff between the cost and the communication levels of IT vendors in Japan and China through the agent-based simulation (Kadono, 2011). This study aims at the preliminary assessment of the future software industry structure in Japan from the viewpoint of the influence of offshoring in China based on surveys on software engineering capabilities of Japanese IT vendors with the METI. Through the agent-based simulation model mainly focusing on customer's price preference and communication quality with customers, Japanese vendors can possibly lose their share of the market if Japanese customers prefer the lower prices offered by offshore vendors. The results suggest that Japanese vendors should improve their communication skill to realize the customer's requirements for the quality of enterprise software while avoiding the cost competition with the Chinese vendors and considering the customer's price preference. Otherwise, some Japanese vendors within the current multi-layered software industry culture will not survive in the drastically changing Japanese market.

CONCLUSIONS AND FUTURE WORK

This paper aims at considering the possibility of the future scenario predictions of Japanese software industry through hybrid method. Thus, we try to preliminarily develop a new research framework by connecting the data obrained by large-scale fact-finding investigations, the statistical analyses results using the dynamic modeling, and the future scenarios of Japanese software industry through the simulation.

This research includes the following characteristics of academic research and expected results and implications. First, the research suggests the guideline of the global technological strategy for Japan's software industry to ensure sustainable competitive advantage through the connection among large-scale social surveys, statistical analyses, and future prospects. Second, the research is a challenge for evidence-based visualization of industrial growth scenario by integrating society's intellectual caliber, which has evolved individually, such as fact-finding investigation conducted by METI and IPA, management theory including resource-based view, competitive threats, and the competitive advantage of nations, statistical analyses like dynamic covariance modeling, and social simulation models. Third, the research has a possibility of evolving of the methods of designing for management of technology as a national strategy, through visualization of optimistic to pessimistic scenarios. By doing this, we do not intend to prospect the future scenarios of the industry precisely, but we pursue deeply understanding the complex and multifaceted issues to be managed by policymakers and leading companies in the software industry in Japan, from the viewpoint of management of technology, considering scale of players, technological paradigm shifts, and global

competitions and collaborations, and so on. Fourth, the methods through the connection among large-scale social surveys, statistical analyses, and future prospects, developed in the software industry in Japan can be expanded to any other sectors in any countries.

We would like to extend our research to include the following future work:
- More precise estimation of population of software industry in Japan,
- More simulation analyses on the speed of the penetration of new technological paradigm into Japanese market, the speed of changes of the cost structure in emerging countries, and the improvement of communication levels between Japanese IT user companies and offshore vendors.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the valuable suggestions and support received from Professor Hiroe Tsubaki at the Institute of Statistical Mathematics, the Ministry of Economy, Trade and Industry (METI); the Software Engineering Center, Information-Technology Promotion Agency, Japan (SEC, IPA); Dr. Seishiro Tsuruho (former president of SEC); the Japan Information Technology Services Industry Association (JISA); and the Management Science Institute Inc. (MSI). This research was partially supported by the grants-in-aid for scientific research from the Japan Society for the Promotion of Science (B: 20310090; C:24530497).

REFERENCE LIST

1. Jay B. Barney (2007), Gaining and Sustaining Competitive Advantage, Pearson Prentice Hall
2. Bollen, K. (1989). Structural Equation with Latent Variables. Wisely-Interscience Publication.
3. Carnegie Mellon University, Software Engineering Institute. Capability Maturity Model Integration (CMMI). http://www.sei.cmu.edu/cmmi/.
4. Epstein, J. and Axtell, R. (1996), Growing Artificial Societies: Social Science from the Bottom Up, Brookings Institution Press
5. Fujimoto, T. (2003). Nouryoku Kouchiku Kyousou (in Japanese). Chuokoron-sha, Inc.
6. IEEE, Computer Society, (2004) Guide to the Software Engineering Body of Knowledge (SWEBOK)
7. Japan Information Technology Services Industry Association (JISA) (2011). Fact-finding Investigation on the IT usage in Japan. JISA.
8. Kadono, Y., Tsubaki H., Tsuruho, S. (2008). A Survey On Management Of Software Engineering In Japan, In Sio-long Ao (Ed.), CURRENT THEMES IN ENGINEERING TECHNOLOGIES (pp. 267-277). The American Institute of Physics.
9. Yasuo Kadono, (2011). AGENT-BASED MODELING OF THE SOFTWARE INDUSTRY STRUCTURE IN JAPAN: PRELIMINARY CONSIDERATION OF INFLUENCE OF OFFSHORING IN CHINA, Proceedings of Technology Innovation and Industrial Management, Oulu, Finland

10. Yasuo Kadono, (2011). A STUDY ON MANAGEMENT OF SOFTWARE ENGINEERING CAPABILITY IN JAPAN USING PANEL ANALYSIS. International Journal of Service Science, Management, Engineering, Technology. 2(3) July-September. pp.pp.20-32 2011/07.
11. Yasuo Kadono, Hiroe Tsubaki, (2012) A Study on the Relationships between Software Engineering Capabilities and Business Performance of Japanese IT Firms through Longitudinal Modeling, Proceedings of THE 16TH PACIFIC ASIA CONFERENCE ON INFORMATION SYSTEMS (PACIS2012), Ho Chi Minh, Vietnam
12. Meredith, W., and Tisak, J, (1990) Latent curve analysis, Psychometrika, 55, 107-122
13. Ministry of Economy, Trade and Industry, Japan(METI). (2010). Fact-finding Investigation on the Software Industry in Japan.
14. Porter, M. (1980). Competitive Strategy, New York: Free Press.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

TOOL WEAR CONDITION MONITORING IN TAPPING PROCESS BY FUZZY LOGIC

**Ratchapon Masakasin, Department of Industrial Engineering,
Faculty of Engineering, Kasetsart University, Bangkok 10900
E-mail: masakasin.r@gmail.com**

**Chana Raksiri, Department of Industrial Engineering, Faculty of Engineering,
Kasetsart University, Bangkok 10900**

ABSTRACT

The objective of this research is to study tool wear condition monitoring in tapping process on CNC machining center machine by using fuzzy logic, to determine the status of cutting tool and the suitable time of changing tool before the tool failure or damage on work piece. The input data that were used in fuzzy logic system obtained from three sensors signal include a spindle current, force and vibration sensor. Fuzzy C-mean clustering and neural network were used to guide in the development of membership function. The status of tool was identified by crisp output values from fuzzy logic system. The results showed fuzzy logic can be used to monitor the tool wear. The performance of fuzzy system based on the number of input data sets and validation of expert in fuzzy rules.

Keywords: Tapping Process, Fuzzy Logic, Tool Wear, Fuzzy C-mean Clustering, Neural Network

INTRODUCTION

Tool wear condition monitoring is important for all metal cutting, such as in tapping process, tool wear or tool breaking has affect to quality of thread and it is difficult or unable to fix it. Then early replacement of tool before tool wear or tool breaking may be safe production loss. There are many techniques are used in monitoring of tool wear. It can be categorized into direct methods and indirect methods. Direct methods require direct measurements from the tool, while the indirect methods utilize cutting parameters such as force, vibration, sound, temperature and power measured during the cutting process. Although the direct methods are likely to be more accurate but it is not feasible in automated machining processes. So the indirect methods are preferred over the direct methods in this field (Aliustaoglu *et al*., 2009).

For indirect methods, fuzzy logics is used extensively to analysis about tool wear and tool condition such as in turning process (Ren *et al.,* 2011), in milling process (Kim and Jeon, 2011; Huang and Chen, 1998) and drilling process (Biglari and Fang, 1995). Other than tool wear and tool condition fuzzy logic can use in applications of data selection for machining parameters with different material and tools type (Hashmi *et al*., 1998; Hashmi *et al*., 2000). These studies showed that fuzzy logic is successful to use in many field of metal machining.

This paper proposes a fuzzy logic model for tool wear condition monitoring in tapping process. In this work has two main stages, the first stage is data collection from sensor signal and adjustment to input to fuzzy system, the membership function and rule base of fuzzy system are designed as show in the second stage.

EXPERIMENTAL SETUP AND DATA ACQUIREMENTS

The first stage, Makino Model BMC60 3-axis CNC milling machine was used in tapping process. A force transducer was mounted on mounting plate under work piece to measured force, accelerometer was mounted on a mounting clip near work piece to measured vibration and current of spindle motor was measured by power logger. The experimental setup as shown in Figure 1. Tap size M6x1 was used in experiment. Machining parameters were set as spindle speed at 200 rpm, feed rate at 200 mm/min and tapping dept 15 mm. The signal of each sensor as shown in Figure 2. The data from each sensor were analyzed to statistical parameters such as mean, maximum, minimum and root mean square (RMS) etc. These statistical parameters were input in to fuzzy modeling.

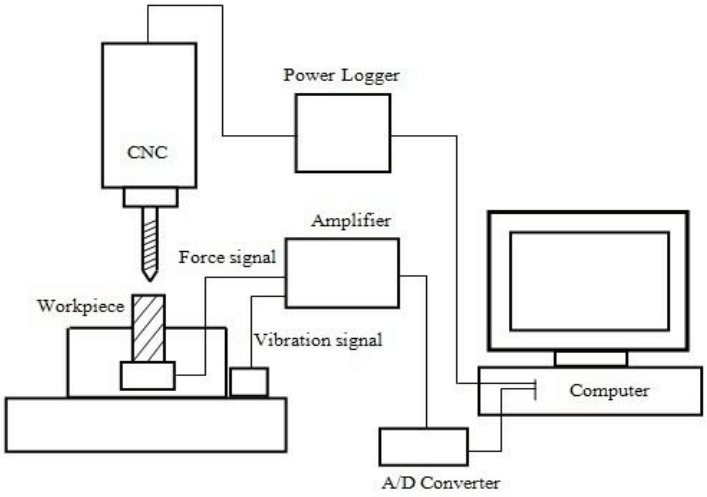


Figure 1. Experimental setup.

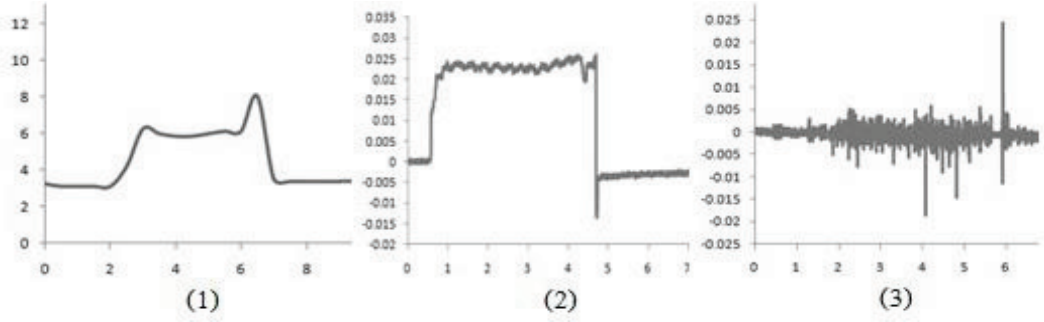


Figure 2. Current (1), Force (2), and Vibration (3) signal.

FUZZY MODELING

In second stage is the development of fuzzy logic system. There are two models of fuzzy system, the first model is the fuzzy system for each sensor that refer to mamdani fuzzy system, and the second model is the fuzzy system for sensors fusion that uses refer to fuzzy system. The output of each sensor was weighted by decision about the important of each sensor before sent to sensor fusion model. Figure 3 shows fuzzy modeling. The statistical parameters of each sensor were sent to input of mamdani fuzzy system and output of mamdani system were sent to input of sugeno fuzzy system. For final output from sugeno fuzzy system is the decision about status of tool.

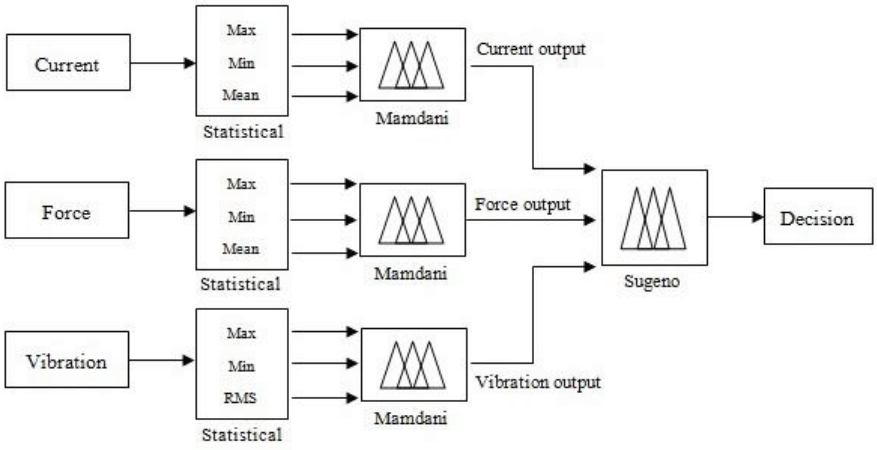


Figure 3. Fuzzy modeling.

1. Fuzzy variable

In mamdani fuzzy system, the inputs and outputs of fuzzy system are explained in fuzzy sets that defined by linguistic terms such as LOW, MEDIUM and HIGH etc. For sugeno fuzzy model the inputs of fuzzy system are explained as same as mamdani fuzzy system, but the output of sugeno fuzzy system is explained with function or constant output (Meesad, 2009). Input and output of fuzzy systems as shown in Table 1.

Table 1. Fuzzy sets for input and output of fuzzy system

Mamdani		Sugeno	
Input (Statistical parameter)	Output (Tool Condition Decision)	Input (Mamdani output)	Output (Wear rate)
LOW MEDIUM HIHG	Normal Tool Warning Tool Failure Tool	LOW MEDIUM HIHG	0.2 0.4 0.6 0.8 1.0

2. Membership functions of fuzzy sets

The structure of fuzzy set and membership function was done manually based on human knowledge or using data-driven technique (Ren *et al*., 2011) such as rank ordering, data clustering, neural networks and genetic algorithms etc. (Meesad, 2009: Ross, 2010). In this work, fuzzy c-mean clustering method was used to calculate center of data in fuzzy sets and calculate membership value for data in fuzzy sets. For development of membership function, the shape of membership function was defined by human expert or use curve fitting technique such as neural network. In this work, neural network fitting tool was used to fit curve between data and membership value from fuzzy c-mean clustering, the result of curve was compared with standard membership function because standard it is easy to calculate output. For example of membership function development can see in Figure 4. The results of comparing were chosen Z S and Gaussian membership function.

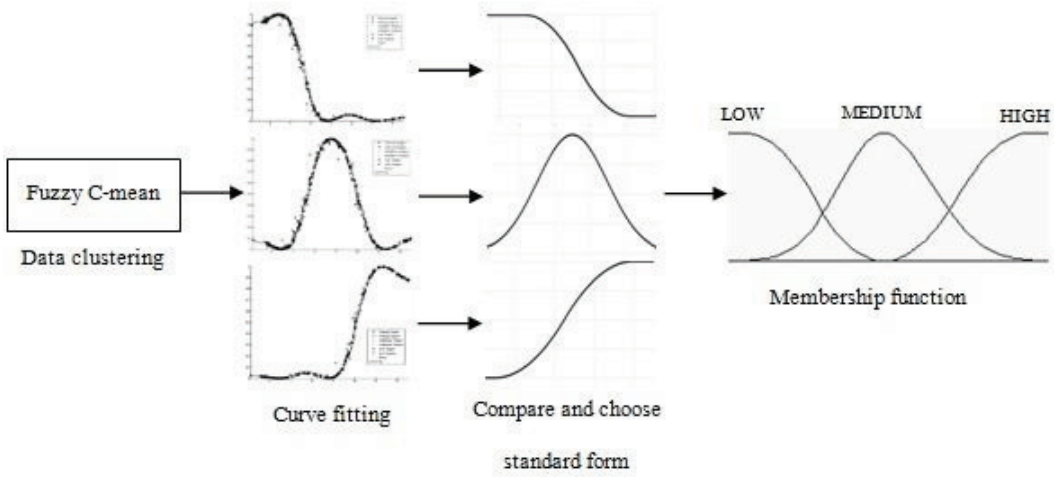


Figure 4. Membership function development.

3. Fuzzy rule-based

The fuzzy rules were defined by if-then rule. They were constructed in the form as:

If (Input1) is … and (Input2) is … and (Input3) is … Then (Output) is …

For example, the rule of mamdani fuzzy system was followed:

If (Min) is LOW and (Max) is LOW and (Mean) is LOW Then (Tool Condition Decision) is Normal Tool.

The rule of sugeno fuzzy systems was followed:

If (Current) is HIGH and (Force) is HIGH and (Vibration) is HIGH Then (Wear rate) is 1.0.

The relationship between inputs and outputs in fuzzy systems was defined based on human expert and engineering knowledge. The number of fuzzy rules in a fuzzy system was related to number of inputs and number of fuzzy variable (Biglari and Fang, 1995). The maximum number of ruled can calculated by the follow equation (Aliustaoglu *et al*., 2009):

$$Z = M^P \quad (1)$$

In this equation, Z is number of fuzzy rules, M is number of input of fuzzy systems and P is number of fuzzy. In this work, there are three inputs of each sensor fuzzy model and three fuzzy variables. Therefore, the maximum number of rules is 27 rules. However, in any cases that have many rules, it is reasonable and efficient to use fewer rules by screening out of impossible rules (Biglari and Fang, 1995). Fuzzy rules of each sensor and sensor fusion model as shown in table 2 and 3 respectively.

Table 2. Fuzzy rules for each sensor model (mamdani)

Min	Max	Mean/RMS		
		LOW	MEDIUM	HIGH
LOW	LOW	Normal Tool	Normal Tool	Warning Tool
	MEDIUM	Normal Tool	Warning Tool	Warning Tool
	HIGH	Warning Tool	Warning Tool	Warning Tool
MEDIUM	LOW	Normal Tool	Warning Tool	Warning Tool
	MEDIUM	Warning Tool	Warning Tool	Warning Tool
	HIGH	Warning Tool	Warning Tool	Failure Tool
HIGH	LOW	Warning Tool	Warning Tool	Warning Tool
	MEDIUM	Warning Tool	Warning Tool	Failure Tool
	HIGH	Warning Tool	Failure Tool	Failure Tool

Table 3. Fuzzy rules for sensor fusion model (sugeno)

Current	Force	Vibration		
		LOW	MEDIUM	HIGH
LOW	LOW	0.2	0.2	0.4
	MEDIUM	0.2	0.4	0.6
	HIGH	0.4	0.6	0.6
MEDIUM	LOW	0.4	0.4	0.6
	MEDIUM	0.4	0.6	0.8
	HIGH	0.6	0.8	0.8
HIGH	LOW	0.6	0.6	0.8
	MEDIUM	0.6	0.8	1.0
	HIGH	0.8	1.0	1.0

4. Fuzzification and defuzzification

Fuzzification is the process of making input data (crisp input) to be the input of fuzzy system (Ross, 2010). Next the input of fuzzy were sent to fuzzy rules and analyzed to fuzzy output. Output of fuzzy system were calculated to output data (crisp output) that used to control systems or decision in any systems by defuzzification method. There are many types of defuzzification in fuzzy system such as centroid, bisector, mean-of-max, weighted-average and weighted-sum etc. In this work, centroid was used in mamdadi fuzzy system and weighted-average was used in sugeno fuzzy system.

RESULTS AND DISCUSSION

The outputs from each sensor fuzzy model and sensor fusion model are showed in Figure 5-6 respectively, it should be a monotonically increasing function which not realizable because of the measurement noise and uncontrolled variable. However, the sensor fusion model with weighting the importance of input data can improve results. For example, in tapping process spindle speed and feed must be related. So spindle current and tapping force are important to monitoring tool wear while vibration is supported to detect about the smooth of cutting. But when looking about quality of signals, high quality signals should be important than low quality signals.

For example in model testing, while in tapping process, the data that measured and analyzed from instruments will sent to calculate in fuzzy model. There are six cases of data in tapping were used to test in this work. The results of model testing as shown in table 4.

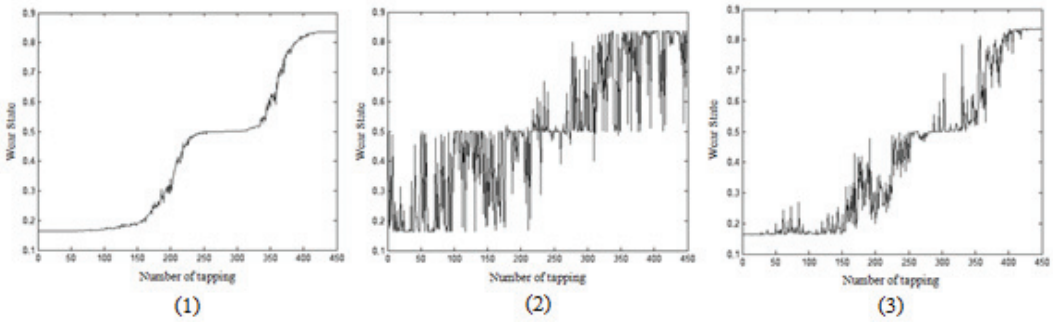


Figure 5. Current (1), Force (2), and Vibration (3) crisp output of mamdani fuzzy.

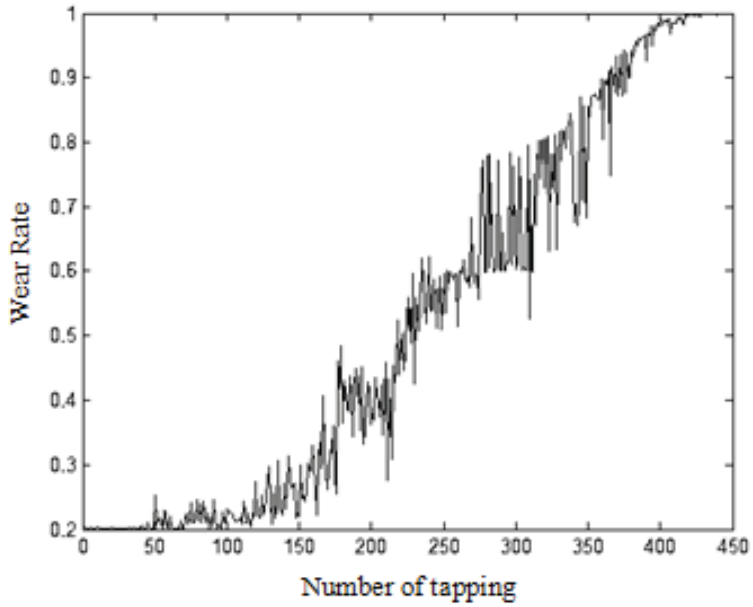


Figure 6. Crisp output of sugeno fuzzy.

Table 4. Results from model testing

Case No.	Sensor	Measurement Data Input			Fuzzy Decision Output	Tool Condition Decision
		Min	Max	Mean/RMS		
1	Current Force Vibration	6.7389 0.0329 -0.0083	7.8299 0.0359 0.0074	7.0766 0.0345 0.0012	0.2325	Normal Tool
2	Current Force Vibration	7.3570 0.0281 -0.0120	8.4408 0.0314 0.0118	7.6170 0.0294 0.0018	0.3313	Normal Tool
3	Current Force Vibration	9.7284 0.0458 -0.0273	10.6798 0.0535 0.0270	9.9719 0.0504 0.0038	0.7708	Warning Tool
4	Current Force Vibration	9.7441 0.0525 -0.0404	10.5621 0.0558 0.0368	9.9521 0.0546 0.0048	0.8169	Warning Tool
5	Current Force Vibration	12.4969 0.0482 -0.0476	13.1789 0.0502 0.0493	12.7049 0.0492 0.0071	0.9998	Failure Tool
6	Current Force Vibration	12.5242 0.0644 -0.0525	13.4792 0.0670 0.0482	12.8891 0.0658 0.0063	1.0000	Failure Tool

The results of fuzzy model explain the status of tool such as, the value closed to zero explains the status of tool is workable, whereas the value closed to one that explains the status of tool is nearly to failure. This value is applied to use in decision-making programs. From results table, tool conditions are set by fuzzy decision output as shown Table 5. For a suitable point of tool changing, operator should be sets a fuzzy decision value of tool changing as one.

Table 5. Tool condition decision setting by fuzzy decision output

No.	Fuzzy Decision Output	Tool Condition Decision
1	0-0.6	Normal Tool
2	0.6-0.85	Warning Tool
3	0.85-1.0	Failure Tool

CONCLUSION

Fuzzy logic can be used to monitoring tool wear in tapping process. The model of fuzzy logic is not complicate and easy to understand. Output from fuzzy logic can apply to use in automatic control or real-time monitoring tool. Fuzzy c-mean clustering and neural network can help expert to develop fuzzy sets and membership function. The matching of expert and data-driven technique can make credibility of fuzzy model more than using only expert opinion. The performance of fuzzy model could be improved by using more data sets of tapping and more input parameters such as feed motor current, machine sound, or tapping torque etc.

ACKNOWLEDGMENT

This research was funded by a research center dedicated to the advanced manufacturing industry in the hard disk drive. College of Data Storage Innovation, King Mongkut's Institute of Technology Ladkrabang contact number DSTAR-R&D 01-01-53, National Electronics and Computer Technology Center, National Science and Technology.

REFERENCES

1. Aliustaoglu, C., Ertunc, H.M., and Ocak, H. (2009), "Tool wear condition monitoring using a sensor fusion model based on fuzzy inference system", *Mechanical Systems and Signal Processing*, 23, 539-546.
2. Ren, Q., Balazinski, M., Baron, L., and Jemielniak, K. (2011), "TSK fuzzy modeling for tool wear condition in turning processes: An experimental study", *Engineering Applications of Artificial Intelligence*, 24, 260-265.
3. Kim, D., and Jeon, D. (2011), "Fuzzy-logic control of cutting forces in CNC milling processes using motor currents as indirect force sensors", *Precision Engineering*, 35, 143-152.
4. Huang, P.T., and Chen, J.C. (1998), "Fuzzy logic-base tool breakage detecting system in end milling operations", *Computers and industrial Engineering,* Vol. 35, No. 1-2, pp. 37-40.
5. Biglari, F.R., and Fang, X.D. (1995), "Real-time fuzzy logic control for maximising the tool life of small-diameter drills", *Fuzzy Sets and Systems*, 72, 9l-101.

6. Hashmi, K., El Baradie, M.A., and Ryan, M. (1998), "Fuzzy-logic based intelligent selection of machining parameters", *Journal of Materials Processing Technology*, 94, 94-111.
7. Hashmi, K., Graham, I.D., and Mills, B. (2000), "Fuzzy logic based data selection for the drilling process", *Journal of Materials Processing Technology*, 108, 55-61.
8. Ross, Timothy J. (2010), *Fuzzy Logic with Engineering Applications*, John Wiley and Sons, Ltd., University of New Mexico, USA.
9. Meesad, P. (2009), "Artificial neural network and fuzzy systems", King Mongkut's University of Technology North Bangkok, Course 223355.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE INTERNET BANNER AD AND USERS' ATTITUDES

William Flores, MBA, Institute of International Management,
National Cheng Kung University, No. 1 University Road, Tainan City 701 Taiwan, ROC
e-mail: liamflores@gmail.com

Jengchung Victor Chen, Ph.D., Institute of International Management
National Cheng Kung University, No. 1 University Road, Tainan City 701 Taiwan, ROC
Telephone: 886-6-275-7575 ext. 53561, e-mail: victor@mail.ncku.edu.tw

William H. Ross, Ph.D., Department of Management
University of Wisconsin – La Crosse, 1725 State Street, Wimberly Hall Room 418 La Crosse, WI 54601 USA
Tel: +1 (608) 785-8450, e-mail: wross@uwlax.edu

ABSTRACT

The study is dedicated to understand the effects of Internet banner ad and the users' perceptions. A lab experiment was used to study the effects of language, product involvement, shape of ad, and type of ad. The subjects were college students in Ecuador. Each experimental website contained a banner ad. The ad was for either a high-involvement product (a smartphone) or a low-involvement product (a news magazine). The type of ad (display ad with photograph vs. text-only, Google-style search ad), shape of ad (horizontal vs. vertical ad), and language of the ad (English vs. Spanish) varied for each type of website. The high-involvement product was seen as significantly more appealing than the low-involvement product, regardless of the type of ad. An interaction suggested that the high-involvement product was seen as somewhat more appealing if advertised with display ads rather than text-only ads; the low-involvement product was slightly more appealing if advertised with text-only ads. Both products – but especially the high-involvement product – attracted higher ratings if advertised with Spanish-language ads rather than English ads. Finally, products were seen as somewhat more appealing if advertised on 'congruent' websites, where the advertised product was similar to the theme of the website (e.g., a smartphone that plays videos advertised on a video website; a news magazine advertised on a newspaper website).

Keywords: Electronic Commerce, Internet advertising; Banner ad; Language of advertisement; High-involvement product; Display ads vs. text-only ads; Visual information

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

DEVELOPMENT OF MRP FRAMEWORK FOR JOB SHOP ENVIRONMENT

Sakurat Intrto, Department of Industrial Engineering, Faculty of Engineering, Kasetsart University

Pornthep Anussornnitisarn*, Department of Industrial Engineering, Faculty of Engineering, Kasetsart University
***Corresponding author: fengpta@ku.ac.th**

Material Requirement Planning (MRP) is the tool often used in operation management by production planner - plan the material procurement by type, required timeframe and quantity. The tool helps production planner to calculate the material requirement accurately and timely. However, material requirement planning is suitable for production environment like assembly line or Flow Shop. In the production environment like job shop or process layout where there are variation of products produced in the system, typical MRP framework struggles with resource requirements calculation such as machine hours, number of operators etc. in order to provide the accurate completion date.

Therefore, this research intend to develop an enhanced version of Material Requirement Planning by factoring in the flow of production process while creating production calculation using Microsoft Office Excel was developed to address this issue. From the analysis of efficiency in calculation table of the enhanced production table by considering only the overload, the researcher found that the overload yielded from new calculation table is more than traditional table. Moreover, when the percentage of overload is reducing, it still yields the overload number as well.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

IDENTIFYING DATA QUALITY/ INFORMATION QUALITY RESEARCH: FRAMEWORKAND EVOLUTION

Tan Zhang, School of Management, Xi'an Jiaotong University, Xi'an, China

Yue Wu, School of Management, Xi'an Jiaotong University, Xi'an, China

Hongyun Zhang, School of Management, Xi'an Jiaotong University, Xi'an, China

Yuewen Liu, School of Management, Xi'an Jiaotong University, Xi'an, China

W. Huang, College of Business, Ohio University, Ohio, USA

ABSTRACT

Over the past three decades, data quality/ information quality (DQ/ IQ) is emerging into a possible distinct discipline. As the research overlaps with other disciplines or research fields such as IS, Marketing, Computing Science, etc., it is important to identify the core characteristics of DQ/IQ research and to study its development over time. Although scholars have make contribution to the identity of DQ/ IQ research through qualitative and quantity approaches, there is lacking of a more objective approach that comprehensively studies the identity and evolution of DQ/ IQ research.

In this study, Latent semantic analysis (LSA) approach was used to identify the core areas and evolution of DQ/IQ research field. Relevant keywords from selected 317 journal papers and conference proceeding papers during 1976 through 2012 were analyzed. We identified five core research areas of DQ/ IQ that have emerged from the research literature in the last 36 years: (1) assessment of DQ/ IQ; (2) computing and technological aspect of DQ/ IQ; (3) DQ/ IQ system application; (4) organizational level impact of DQ/IQ; (5) data process management of DQ/ IQ. By examining the evolution of DQ/ IQ research over the past 36 years, we found that the core areas have remained stable, but the topics within each core area appeared and disappeared over time. We conclude that DQ/IQ research has remained relatively stable by focusing on the DQ/IQ research cycle of data/ information management: technology → application → process management → assessment → impact. Insights and suggestions are discussed and presented finally for future research.

INTRODUCTION

Over the past three decades, DQ/IQ has become an important research field which has made significant contribution to the MIS academic discipline. There are various topics in this field, including technical oriented topics such as database related technical solutions for data quality, behavior oriented topics such as data quality impact, web and environment oriented topics such as data quality in the context of computer science and IT [1]. According to the senior editors of the *ACM Journal of Data and Information Quality,* after develop from different relevant disciplines, DQ/IQ research has been shifting to a more unified and distinct discipline. However, as the research field overlaps with other disciplines or fields, it is badly needed to identify the core characteristics of DQ/IQ and to study its development over time.

It is the strong and distinct identity that makes a continuous development and success of the discipline [2, 3].

This research focuses on the identification of core topics and themes in DQ/IQ field. In addition, we aim to trace the evolution and development of DQ/ IQ research over the past 30 years. In this research, we applied latent semantic analysis (LSA) to identify the core areas and evolution of DQ/IQ field by analyzing keywords of 317 full-text DQ/ IQ research papers that were found through a structured approach recommend by Webster and Watson (2002) [4].

The rest of this paper is organized as follows. In the next section, we review the current literature from three aspects: topics, frameworks and identities. Then, we describe the application of LSA and data collection process. Thirdly, results are analyzed. At last, conclusion of key findings, limitations were discussed and directions for further research were suggested.

LITERATURE REVIEW

The topic of identification of disciplines has been discussed for a long time. Sidorova et al. (2008) used LSA to determine the intellectual core of the IS discipline and examined the evolution of IS research over time, and posit IS among the business disciplines. They identified five core research areas: (1) information technology and organizations; (2) IS development; (3) IT and individuals; (4) IT and markets; and (5) IT and groups. In addition, the five core areas remained quite stable, but the specific research themes in the core areas have changed greatly over time [5].

Same as the identity research on IS discipline, scholars have made contribution to the identity of DQ/ IQ research through qualitative and quantity researches on categorize/ clustering DQ/ IQ's research dimensions, topics, and themes. Wang et al. (1995) did a qualitative research to analyze the state-of-art of DQ and developed a framework of DQ research by analogizing product manufacturing and data manufacturing adapted from ISO 9000 [6]. The framework includes seven elements: (1) management responsibilities; (2) operation and assurance costs; (3) research and development; (4) production; (5) distribution; (6) personnel management; and (7) legal function. However, the seven elements are not sufficient to characterize DQ/ IS research and are difficult to be used [1]. Through the qualitative research of 171 papers published form 1995 to 2005, Lima et al. (2006) came up with the conclusion that the relationship between IS and DQ/ IQ research is parallel, and then developed the conceptual maps of DQ research with three high-level perspectives of DQ research: the organizational, behavioral, and operational views, which have detailed conceptual map of relationships between keywords and clusters for each perspective [7]. Ge and Helfert (2007) did a comprehensive review of information quality research review, proposing three major areas of DQ/ IQ research: information quality assessment, information quality management and contextual information quality, which qualitatively built a framework of DQ/ IQ research and emphasized the characteristic of this research field [8]. Madnick et al. (2009) qualitatively introduced a framework for DQ/ IQ research along two dimensions: topics and methods, and provided several representative papers to illustrate relevant topics and methods [1]. The authors also provided intuitive and commonly used keywords to describe each topics, which helps people to characterize individual papers and determine which topics it will belong to.

Recently, Blake (2010) did a quantitative research to identify core topics and themes on DQ/ IQ. He analyzed the abstracts of 324 data quality and information quality papers, and used LSA to analyze all the abstracts of these articles. The author concluded that this research consists of six core topics and fifteen core themes of data quality and information quality research [9]. Blake (2010) also pointed out that future research should focus on the evolution of DQ/ IQ research over time [9].

Although the research on the identity of DQ/ IQ research has had considerate large sum of research contributions, there are several limitations of the former research. First of all, the qualitative researches objectively lead, determined, or recommended the structure, core areas, topics, and methodology of DQ/ IQ research through manual statistical analysis, which may neglect the subject perspective that start from the mathematical analysis of published paper. However, quantitative research using LSA can provide a different perspective to look into the DQ/ IQ research [9]. Secondly, the recent quantity researches of DQ/ IQ are not sufficient, for example, the evolution of DQ/ IQ research over the past twenty years should be studied to find the trend of this field [9].

The next section introduces the methodology of LSA to identify core DQ/ IQ areas and corresponding themes through a quantitative way.

METHODOLOGY

1. Introduction of LSA

The main idea behind LSA is to collect all of the contexts within which words appear, and to establish common factors that represent underlying concepts [5, 10]. The main purpose of LSA is the reduction of dimensionality of original data through singular value decomposition (SVD). SVD is a form of factor analysis applied to a t by d term-document matrix.

In order to process the unstructured data efficiently in LSA, it has to be transformed into a structured form (i.e., vector/matrix). The normal method is the term frequency and inverse document frequency (TF-IDF) transformation. TF-IDF transformation or quantification is a term-frequency based mechanism by which a sequence of words (e.g. a sentence, an article) can be transformed into a structured quantified vector. The raw term frequencies are refined to the product $wij = tfij * idfi$, where $idfi = \log2(N/ni) + 1$, where N is the number of documents in the collection, $tfij$ is the raw term frequency of term i in document j, ni is the term frequency of term i in the entire collection of documents, and the inverse document frequency (IDF) $idfi$ serves as a metric of rarity of term i in the entire collection of documents. Thus, the occurrence of rare terms is promoted and the influence of more common non-stop words is discounted. Then, the term frequencies are typically normalized so that the sum of squared transformed frequencies of all term occurrences within each document is equal to one. Hence, a document can be represented as a vector of term frequencies.

However, the original vectors of term frequencies are usually highly dimensional. Singular value decomposition (SVD) is utilized to reduce the dimension of the original document vectors. By SVD, a $t \times d$ matrix $\mathbf{X}$ can be expressed as $\mathbf{X} = \mathbf{TSD}T$ where $\mathbf{T}$ and $\mathbf{D}$ are both orthogonal and S is diagonal. If X is a $t \times d$ matrix of terms by documents containing the raw

or weighted term frequencies, **TS** is called the factor loadings for terms and **DS** is the factor loadings for documents. Interestingly, **T** is the $t \times r$ matrix of eigenvectors of **XXT** (term covariance), **D** is the $d \times r$ matrix of eigenvectors of the square symmetric matrix of **XTX** (document covariance), and **S** is an $r \times r$ diagonal matrix containing the square roots of eigenvalues of both **XXT** and **XTX**, where r is the rank of **X**. By retaining a proper number of significant factor k, X can be represented by its least squares approximation **X**' = **T***k***S***k***D***k*, which not only reduces the dimensions of some corresponding matrices but also filters some noises in the original representation.

In order to promote the significance of more important terms and discount the significance of less important terms, factor rotation technique is often adopted to achieve this. Usually, the term loadings **L**T = **T***k***S***k* is rotated into **L**T**M** and the document loadings **L**D = **D***k***S***k* is rotated into **L**D**M** by multiplying them by a rotation matrix **M** according to some term structure simplification. A representative factor rotation method is called the varimax rotation [5].

2. Data Collection

To build our corpus, the keywords are chosen from relevant DQ/ IQ journal articles and proceedings of conferences central to the data quality research using a structured approach recommend by Webster and Watson (2002) [4].

(1) We use "Information Quality", "Data Quality", "Quality of Data", and "Quality of Information" as keywords to search papers published on the leading journals in IS discipline before July 2012 in date. Journal databases ABI/Inform (ProQuest) was used to identify relevant articles in the top five leading journals from MIS Journal ranking (2011) by Association for Information Systems, including MISQ, ISR, CACM, MS, and JMIS. In addition, we reviewed all the available papers on proceedings of International Conference on Information Quality (ICIQ) from 1995 to 2007, which is the only international conference specifically targeting DQ/ IQ field with a reputation for quality.

(2) We go backward by reviewing the citations for the articles identified in step 1 including Information Quality framework and/ or instrument to determine prior articles we should consider.

(3) We go forward by using Web of Science to identify articles citing the key articles identified in the previous steps to determine which of these articles should be included in the review.

Through these three steps, we have collected 317 full-texts DQ/ IQ related papers

3. Pre-processing

LSA begins with treating keywords of each article as a set of unstructured words. The text of the keywords of 317 articles were processed with several routinely used pre-processing steps such as stop words removed and stemming prior to latent semantic analysis [11].
Stop words. After numeric values and punctuation were removed, the following step is to remove stop words. Stop words are usually meaningless and not useful for the analysis.

Stemming. Stemming can transform these words which share a same root term to a related form in order to increase identification of similar words and avoid redundancy to reduce processing time at the same time. For example, stemming might transform "contribute", "contribution", "contributing", "contributes" and "contributed" all to the same root term "contribut". For our analysis we used the Snowball stemmer, which is an implementation of a popular stemming algorithm.

RESULT

1. An Overview of Different Factor Solutions

The result of LSA analysis was used to find semantically related terms and their loadings on each factor. Just like general factor analysis, each factor was related to its high loading terms and documents, which are both necessary to interpret the corresponding factor. For each factor, high loading terms and documents which are sorted by absolute loading value are selected to help interpret and label the factor. All factor solution can be proved meaningful by a reasonable factor interpretation. Examination of different factor solution suggests that the body of DQ/ IQ can be aggregated at different level, in other words, different factor solution reveals different aspect of the DQ/ IQ discipline.

Combined with the reference of earlier empirical studies and the result of different factor solution, we finally chose five factors for topics and fifteen factors for themes in order to have the most meaningful representations.

A meaningful view of the intellectual core of the DQ/ IQ discipline are provided by five research topics, and each topic can be represented through several research themes. Four of the five factors containing the solution can be interpreted as the problem-oriented research, examining the application, assessment or impact of one or some specific research issues; they include (1)assessment of DQ/ IQ, (3) DQ/ IQ system application, (4) organizational level impact of DQ/IQ, and data process management of DQ/ IQ (5). (3) DQ/ IQ system application examines the specific applications in the practice of DQ/ IQ research; from its corresponding research themes (see Table 1), this research topic focuses primarily on the improvement of data quality in systems, entity resolution application, corporate house-holding and supply chain, entity resolution application. (5) Data process management of DQ/ IQ examines how to process information as well as data effectively in the management of DQ/ IQ. Here, the research themes focus on DQ/ IQ standardization, measure tool and processes management. At the next level, (1) assessment of DQ/ IQ examines how to assess the quality of information and data in practice. Here, research focuses on information quality measurement model, metrics and assessment, user satisfaction and IS success. Next, (4) organizational level impact of DQ/IQ focuses on the implications of DQ/ IQ research use for organizations, such as the effect of DQ/IQ on business processes, and the impact of DQ/ IQ investments on organizational performance. Research at this level has also focused on business practices related to the impact of DQ/ IQ, such as security and trust, as well as the cost-benefit analysis of DQ/ IQ.

While these four research areas are problem-oriented, the fifth distinct research area, (2) computing technology of DQ/ IQ is technology-oriented. It examines the computing technology itself, and how it processes to improve DQ/ IQ. Here, the research tends to be

more technical in nature, largely focusing on the following themes, including entity identification, database and programming method, DQ/ IQ in network analysis technology, as well as data integration and clean.

According to the interpretations of the five research topic, the intellectual core of the DQ/ IQ discipline can be summarized into problem-oriented research and technology-oriented research, which specifically are the application, process management, assessment and impact of specific DQ/ IQ issues in practice, as well as how computing technology is processed and applied on DQ/ IQ.
In the following section, we will discuss how the topics and themes of DQ/ IQ research have varied over time.

2. Dynamics of IQ and DQ research

To examine the dynamics of DQ/ IQ research, we account total number of publications in different period of time in 15 research topics identified above and calculate the proportion of each topic in corresponding period. The time periods are chosen as 1990- 1999, 2000- 2009, and 2010- 2012 (as our data collection was ended in 2012). This analysis indicates the focus and popularity of changing research topics in different time periods, which provides an evidence of the evolution of DQ/ IQ research. The result is in Table 1.

Figure 1 examines the proportion of total number of five areas' publications and Figure 2 examines the proportion of each theme. (1) Assessment of DQ/ IQ accounts for the largest attention of researchers, and (3) DQ/ IQ system application ranks the second. Figure 3 shows the proportion of each area in different time period, which indicates the popularity of each area in different times. We can see from Figure 3 that most of the five areas remain constant over 30 years. Specifically, the proportion of (3) DQ/ IQ system application and (4) organizational level impact of DQ/IQ grew steadily over time; (1) assessment of DQ/ IQ and (5) data process management of DQ/ IQ first grew from 1990s to 2000s, but fell down slightly in 2010s. The last research area, (2) computing technology of DQ/ IQ experienced a dramatic fluctuation over time, however. It fell from 1990s to 2000s sharply and grew significantly when time came to 2010s.

Table 1. Areas and Topics in Different Times

Area	Topic	1990s	2000s	2010s (part of)
1. assessment of DQ/ IQ	user satisfaction and IS success	0.12	0.08	0.10
	information quality measurement model	0.12	0.18	0.10
	metrics and assessment	0.04	0.06	0.00
2. computing technology of DQ/ IQ	entity identification technology	0.04	0.00	0.04

Area	Topic	1990s	2000s	2010s (part of)
	database and programming method	0.04	0.05	0.10
	DQ/ IQ in network analysis technology	0.12	0.06	0.08
	data integration and clean	0.12	0.00	0.05
3. DQ/ IQ system application	data quality improvement in systems	0.04	0.00	0.05
	corporate house-holding and supply chain	0.04	0.14	0.09
	entity resolution application	0.12	0.05	0.10
4. organizational level impact of DQ/IQ	security and trust	0.00	0.04	0.00
	cost-benefit analysis	0.08	0.07	0.05
	operation and decision system	0.04	0.08	0.14
5. data process management of DQ/ IQ	measure tool and processes management	0.12	0.15	0.10
	DQ/ IQ standardization	0.00	0.05	0.00

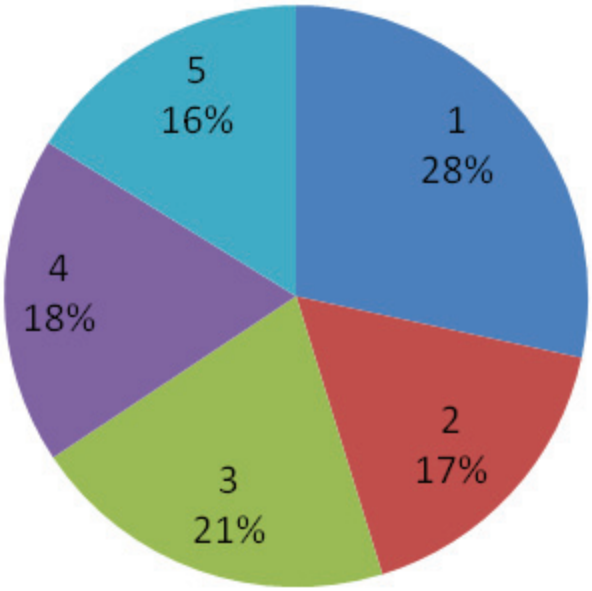


Figure 1. Ratio of Each Area

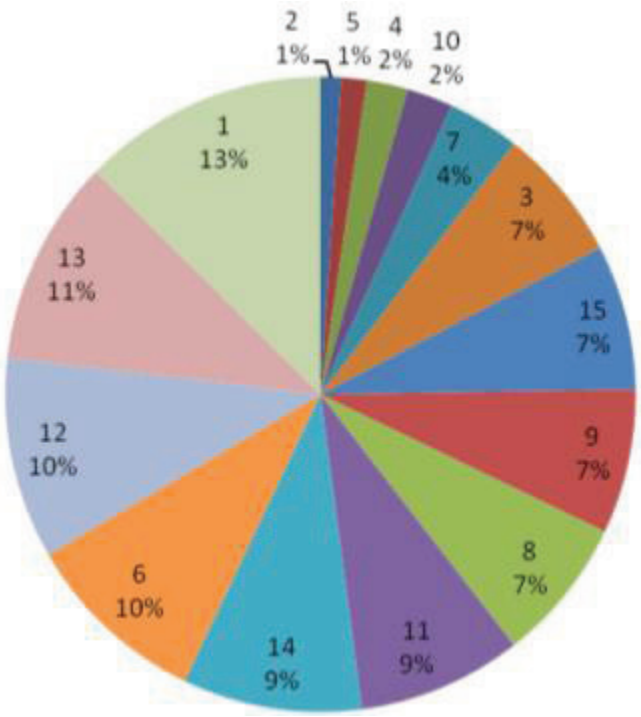


Figure 2. Ratio of Each Topic

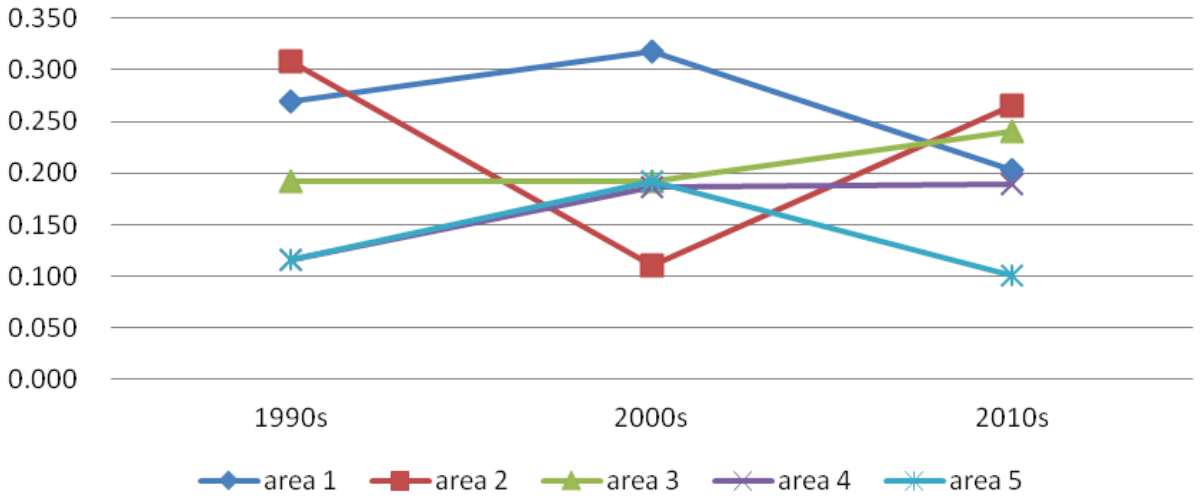


Figure 3. Dynamics of Research Areas

Examination of cross-loadings of 5 research areas and 15 research topics shows that the focus topics in some research area in different time period changes (see Table 1). For example, in (2) computing technology of DQ/ IQ, database and programming method was the focus topic in 1990s and 200s, and was replaced by database and programming method in 2010s. In (3) DQ/ IQ system application, the topic of corporate house-holding and supply chain was not popular in 1990s, but gained the largest focus in 2000s. Similarly, operation and decision system in (4) organizational level impact of DQ/IQ gained continuous increasing attention over time and has grown into the focus topic of this area. Implications of significant changes in the five research areas are examined in the next part.

DISCUSSION

The focus areas in DQ and IQ research changes over time as the landscape of data quality in research and data quality in practice changes quickly [9]. To identify the evolution of DQ/ IQ research, we need to examine the dynamic changes and focus shifts in the five core areas identified above. In this part, we discuss about the changes in DQ/ IQ research over the last 30 years, based on the results of our former part.

Firstly, the examination of dynamics of five research areas shows that although some of the areas fluctuated in the past 30 years, the areas remained stable over time. DQ/ IQ research is tightly combined with technology and management [1]. The raise and falls in one research area provides research space for other areas, for example, the development of DQ/ IQ research technology promotes the application, assessment, and data process management, and change the impact of DQ/ IQ, while the application encourage the improvement of technology and data process management. The five research areas form a cycle of DQ/ IQ research: technology → application → process management → assessment → impact → new demand of technology. In addition, the uptrend of (3) DQ/ IQ system application and (4) organizational level impact of DQ/IQ shows that DQ/ IQ research has changed from monotonous areas of computing technology and assessment to more balanced areas that also focus on DQ system application and impact. The combination of technology and management, and the movement from technology toward process-related and managerial

issues makes DQ/ IQ research more identifiable from IT, computing science, and other management research [1, 3].

Secondly, we can explore the results of each research area, the significantly changing of the topics, to find the dynamics characteristics. The result indicates that although many topics remain stable over time, such as user satisfaction and IS success, DQ/ IQ in network analysis technology, and measure tool and processes management, there are some interesting and important changes. We can see from Table 1 that the topic of information quality measurement model accounts for the largest amount of publications in DQ/ IQ research, which is one of the core concerns of DQ/ IQ field. However, examining the dynamic development of this topic, after going up from 1990s to 2000s, this topic fell down sharply through 2010s (from 18% to 10%). This suggests that after ample study of measurement of DQ/ IQ model in 2000s, researchers have gradually reached a consensus of how to measure data quality or information quality. The focus of (1) assessment of DQ/ IQ is shifting to user satisfaction and IS success, which take more factors into consideration other than measurement to assess DQ/ IQ.

Main computing technologies of DQ/ IQ evolved over time, too. Database and programming method gains more and more concern over three period of time and finally ranks the top concern in 2010s among these four technologies, while data integration and clean fell sharply. The result suggests that as computing technology evolves, more and more researches focus on improving database and programming method to study DQ algorithm and solve DQ problems.

In the area of organizational level impact of DQ/ IQ, topic of cost-benefit analysis declined while topic of operation and decision system increased over time, which indicates that more and more organizations accept the necessity and significance of DQ & IQ, and impact of operation and decision system for DQ solution are becoming more and more popular while the cost-benefit issue has reached an agreement.

CONCLUSIONS, LIMITATIONS, AND DIRECTIONS FOR FUTURE RESEARCH

In this paper, we attempted to reveal the intellectual core and corresponding research dynamics of DQ/ IQ research. The key contribution of the paper is that we applied latent semantic analysis to identify and interpret the five core topics of DQ/ IQ and fifteen research themes to identify DQ/ IQ research. In order to better understand the trend of DQ/ IQ research, the evolution of this field in the past three decades was also discussed.

It is also important to point out several limitations of our study. First, we used keywords instead of full texts or abstracts, which may loss of information. Second, since factor labeling was done by researchers, it is hard to avoid the limitation of subjectivity biases. In addition, our sample was consisted by certain mainstream journal articles and conference proceedings which may limit the scope of our study.

Our research is a quantitative methodology based on latent semantics analysis. Our future work may consider the combination of earlier qualitative empirical studies and the method in our paper, eliminating the shortcomings of the empirical studies and adding their advantages. By comparing the two methods, we can try to propose a comprehensive and complementary

approach to address the DQ/IQ topic identification. Besides, our sample covers most of mainstream journal articles and conference proceedings such as ICIQ, CACM, MISQ, JMIS, etc. Some of them are oriented for North American, while some focus on European research. In this paper, we do not take this locality distinction into consideration. Maybe, a comparative study of North American versus European DQ/IQ research identities could be an interesting direction for future research.

For future research, researchers can explore new research topics, such as new technology and management to ensure semi-structured and unstructured data quality, cross impact of DQ/ IQ on individual and organizational, and so on. In addition, the cycle of these five core topics need more theoretical and empirical study to confirm.

In conclusion, the core view of DQ/ IQ in research as well as in practice is changing quickly overtime. As the development of discipline research and information technology, organic combination of DQ/ IQ and other disciplines will become a new main trend, and also bring new research challenges at the same time. We hope our study of DQ/ IQ discipline can enable new scholars to efficiently gain an understanding of what DQ/ IQ research is and identify potential areas of interest in a clearer and easier way.

REFERENCES

1. Madnick, S.E., Wang, R.Y., Lee, Y.W., and Zhu, H. (2009), "Overview and Framework for Data and Information Quality Research", ACM Journal of Information and Data Quality, Vol. 1, No. 1, pp 1-22.
2. Benbasat, I., and Zmud, R. W. (2003), “The Identity Crisis Within the IS Discipline: Defining and Communicating the Discipline’s Core Properties”, MIS Quarterly, Vol. 27, No. 2, pp. 183-194.
3. Robey, D. (2003), “Identity, Legitimacy and the Dominant Research Paradigm: An Alternative Prescription for the IS Discipline. A Response to Benbasat and Zmud’s Call for Returning to the IT Artifact”, Journal of the AIS, Vol. 4, No. 7, pp. 352-359.
4. Webster, J., and Watson, R.T. (2002), “Analyzing the past to prepare for the future: writing a literature review”, MIS Quarterly, Vol. 26, No. 2, pp. xiii-xxiii.
5. Sidorova, A., Evangelopoulos, N., Valacich, J.S., and Ramakrishnan, T. (2008), "Uncovering the intellectual core of the information systems discipline", MIS Quarterly, Vol. 32, No. 3, pp 467-482.
6. Wang, R.Y., Storey, V.C., and Firth, C.P. (1995), "A framework for analysis of data quality research", IEEE Transactions on Knowledge and Data Engineering, Vol. 7, No. 4, pp 623-640.
7. Lima, L., Maçada, A., and Vargas, L. (2006), "Research into Information Quality: A Study of the State-of-the-Art in IQ and its Consolidation", International Conference on Information Quality, Cambridge, MA.
8. Ge, M., and Helfert, M. (2007), "A Review of Information Quality Research", International Conference of Information Quality, Cambridge, MA.
9. Blake, R. (2010), "Identifying the core topics and themes of data and information quality research", AMCIS 2010 Proceedings. pp. 221.
10. Larsen, K.R., Monarchi, D.E. (2004). “A Mathematical Approach to Categorization and Labeling of Qualitative Data: the Latent Categorization Method”, Sociological Methodology, Vol. 34, No. 1, pp. 349-392.

11. Hovorka, D., Larsen, K. and Monarchi, D. (2009), "Conceptual convergences: Positioning information systems among the business disciplines", In Proceedings of the 17th European Conference on Information Systems (ECIS) (NEWELL S, WHITLEY E, POULOUDI N, WAREHAM J and MATHIASSEN LEds), manuscript 0217.R1.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

VALIDATING PERFORMANCE BASED CRITICAL ACTIONS IN A HIGH TECH START-UP

Veli-Pekka Vuoti, Department of Production, University of Vaasa, Vaasa, Finland
veli-pekka.vuoti@student.uwasa.fi

Josu Takala, Department of Production, University of Vaasa, Vaasa, Finland
josu.takala@uwasa.fi

Wenshan Yang, Department of Production, University of Vaasa, Vaasa, Finland
yangw@student.uwasa.fi

Nurul Aida binti Abdul Malek, Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia (UTHM), Johor, Malaysia
aida@uthm.edu.my

Yang Liu*, Department of Production, University of Vaasa, Vaasa, Finland
yli@uva.fi

Alexander Mäntylä, Department of Production, University of Vaasa, Vaasa, Finland
v98949@student.uwasa.fi

Patricia Kronman, Department of Production, University of Vaasa, Vaasa, Finland
v98945@student.uwasa.fi

Andreas Kreuzer, Department of Production, University of Vaasa, Vaasa, Finland
v98944@student.uwasa.fi

Afnan Zafar, Department of Production, University of Vaasa, Vaasa, Finland
v98960@student.uwasa.fi
(* Corresponding author)

ABSTRACT

Purpose: *A proposed analytical model in this research analyses the corresponding angles of the strategic triangles (Prospector, Analyzer, and Defender). The model compares the angle differences between the strategy and resource triangles with opinions from different management groups of informants. It was found out that NSCFI model more scientific comparing to formal ones through validation. The objective of this study is to analyse a Finnish manufacturing case company's operational competitiveness. Operational strategy is a vital element that supports businesses corporate strategies. The strategic decision-making is essential in operational competitiveness to generate quality decisions that would affect the successfulness of strategy formulation in manufacturing and sales.*

Methodology: *The research is based on two methods; Manufacturing Strategy Index (MSI) and Sense and Respond (S&R). MSI detects the preferable strategy type and derives the proportions of importance between quality, cost, time and flexibility. Whilst, S&R analyzes dynamic business strategies and deviates influence on each attribute on the same four performances as in MSI.*
Findings: *The instruments used for data collection are questionnaires custom made for the company. Calculations based on the MSI questionnaire resulted in medium high values for the Prospector strategy both for past- and future orientation. S&R calculations regarding the past orientation resulted in low values for all strategy types, except P-NSCFI for Analyzer.*
Originality: *The managerial implication of this research is that it is critical for enterprise managers to adjust the direction of operations strategy according to consistency between operation strategy and resource allocation. Concerning the future orientation, we find high values for Analyzer and medium low to high values for the Prospector and Defender groups. The results would indicate that the case company has turned from a former strategy that was not clearly defined towards a highly Analyzer characterized business strategy.*

Key words: Sustainable Competitive Advantage, Sense and Respond, Manufacturing Strategy Index, Operations strategy, Case study

INTRODUCTION

As the rapid development of global economics, manufacturing enterprises are trying to find out a survival path to be stable in the competitive market and get benefit as much as it can be. Many manufacturing companies took convey and analysis to help managers make decision. It is undoubtedly that quantitative analyzing will provide management more assistance with numerical data. The idea has been modified by changing both denominator and nominator with rational level values in previous SCFI formulas (Liu, et al., 2011). Takala draw out the idea of using triangles to comparing operations strategy and resource allocation. The NSCFI model was developed by Liu and the new model accurately the S&R theory and trend research into the study. This proposed model further improves the accuracy and stability of NSCFI modeling and evaluating business strategic decision-making process, based on feedback on case studies using NSCFI. Through analysis of this case study it can be find out that to some degree several Sense & Response models have similar results, however the NSCFI give managerial implication with high accuracy comparing to formal ones.

This paper analyses the corresponding angles of the strategic triangles (Prospector, Analyzer, and Defender) and compare the angle differences between the strategy and resource triangles with opinions from different management groups of informants. In addition, this study develops a new S&R model named new critical factor index (NSCFI) model which based on formal models refers to CFI, BCFI, SCFI. And it is critical for enterprise managers to evaluate whether the operations strategy supports their resource allocation then it is more efficient to make decisions. The proposed analytical model created in this research provides benchmarking to BCFI and SCFI base on testing the hypothesis with the NSCFI model.

According to Takala (2013), the case study from one Finnish manufacturing company provided validation of the NSCFI model is the best until now. However, it needs to be proved in a large number of case studies and this case company is just one of our study area. In this paper, our validation comes from different departments of one Finnish company which initially a smaller Finnish company offering logistic services and products for the metal industry but has recently been acquired (purchased) by a bigger Finnish manufacturing company. This company is the world's leading professional related manufacturer, a wide range of business, including manufacturing and processing industries, shipbuilding, ports and terminals. The analyzing result has been taken from company managers´ operations feedback.

The structure of this paper is as follows. Section 2 introduces the study objectives. Section 3 reviews the latest related studies. Section 4 describes the methodologies. Section 5 draws findings of this study. Section 6 discusses the managerial implications, research limitations and also recommendations for future research.

LITERATURE REVIEW

Johnson describes strategy as 'the direction and scope of an organization over the long-term, which achieves advantage in a changing environment through its configuration of resources with the aim of fulfilling stakeholder expectations' (Johnson at al. 2005). Mintzberg states that strategy is organization's future plan, a position in specific markets, a pattern of its performance and a tactic to left behind its competitors (Mintzberg, et al., 1998).

Companies construct their strategies in many ways. They can compete either on cost, quality of products or services, high levels of customer service or customizing their products and services to fit individual customer needs. The operations function therefore must respond to this by providing the capabilities needed to fulfill the market requirement. In some ways this is a 'translation' task because the techniques and language used by marketing managers to understand the requirements of markets are different to the language and techniques used by operations managers to manage their productive resources. Slack and Lewis (2002) defined operations strategy as the pattern of decision which shape the long term capabilities of any type of operations and their contribution to overall strategy, through the reconciliation of market requirements with operations resources. The main vision of each company is to have an operational strategy that will keep the company growing. One of the key features of such strategy is the one that gives a way towards a unique strategic position in the market. According to Skinner (1986), the new competitive environment forces manufacturing companies to have a quick response to market demands, deliver high quality products, and the industrial system have to be flexible to new materials and customer needs. Therefore, continuous innovations are needed if the company wants to continuously growing and remain profitable over time. A well formulated strategy would help companies to allocate their resources wisely according to their capabilities and shortcomings in a dynamic environment.

Miles & Snow topology (1978) is a dominant framework of the strategy types. They have developed a comprehensive framework which states that the strategy type can be detected depending on the fixed proportions between RAL Model elements (Quality, Cost,

Time/Delivery, and Flexibility). According to this framework, there are four different groups; prospectors, defenders, analyzers and reactors. Prospector strategy is the one that always looking forward for opportunity to lead the industry through innovation. Defender strategy tries to maintain their current customer by taking advantage in cost to create a stable market. Analyzer strategy is an intermediate between defender and prospector strategy which tries to balance between quality, cost and time. Reactor strategy has no sense of aims or vision. Under this strategy, the decisions are taken in order to respond to immediate problem.

METHODOLOGY

Two methodologies apply in this case study: Manufacturing Strategy Index (MSI) and Sense and Respond (S&R). MSI refers to the operations strategy whereas S&R refers to resource allocation of a company. Both methodologies have a two-sided orientation: Past and future. Attributes are to be assessed for the situation during the past 3-5 years as well as the expectations for the future 3-5 years or equivalent dimensions. In this case study, informants were asked to assess the situation before and during the economic crisis of 2008/2009. Data was gathered by sending questionnaires to two white-collar employees of the case company. The first questionnaire covered the MSI criteria while the second set of questions asked for the attributes in Sense and Respond.

1 Sense and Respond (S&R)

The term ‘Sense and Respond’ as a business concept first appeared in the 1992 *Management Review* article by Stephan H. Haeckel. Originally a label describing a desirable type of organizational behavior, it evolved over the next six years into a post-industrial managerial paradigm, incorporating a set of concepts, principles, prescriptions and tools for creating and managing an adaptive enterprise. (H. Haeckel 1999)

According to Ivan Golovko (Golovko, 2012), 'Sense and Respond' is a scalable managerial framework developing ability to adopt improvements. To further describe S&R, it's important to mention the current framework used by organizations, 'Make and Sell'. This lower level framework will not allow organizations to operate as competitive as possible nor will they compete in the fierce and constantly changing business environment. Mr. Golovko describes S&R as "converting threats into opportunities, drawbacks into strengths."

The Sense and Respond questionnaire is used to analyze dynamic business strategies. In the S&R questionnaire you deviate accordingly to the influence of an attribute on Quality, Cost, Time and Flexibility of the business performance process. The main criteria (Quality, Cost, Time and Flexibility) have their sub-criteria, which leads to better understanding of RAL Model. (Figure 1)

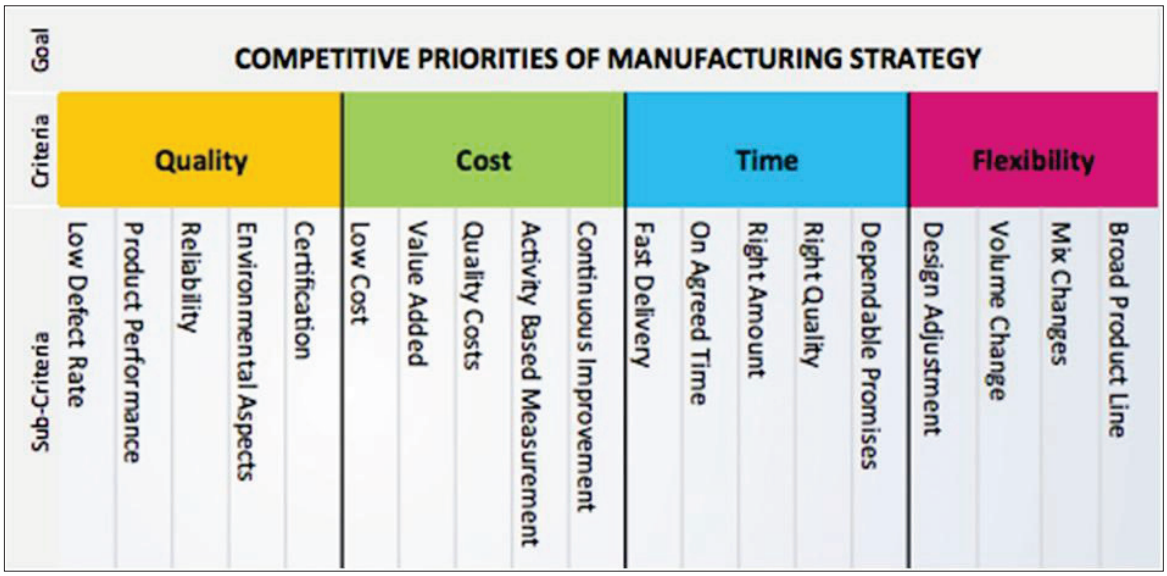


Figure 1: Basic elements of RAL model

The S&R was utilized by Ranta and Takala (2007) by introducing critical factor index (CFI) to develop the operative management system. After introducing CFI, the S&R model has develop with three stages, which are called CFI, BCFI and SCFI model. The three models have common parts and the different parts are the numerator. The S&R model is used to analyze CFI of case companies.

The S&R questionnaire had 32 attributes to value. Quality had 7 attributes, Cost had 10 attributes, Time had 7 attributes and Flexibility had attributes of 8.

Please answer to all attributes to form a useable answer. ATTRIBUTES	Experiences	Expectations	Direction of development, experiences (past) X			Direction of development, expectations (future) X			Compared with competitors X		
	(1-10)	(1-10)	Worse	Same	Better	Worse	Same	Better	Worse	Same	Better
RESOURCE INPUTS IN MULTI-CRITERIA OPERATIONS STRATEGY											
Quality											
Time											
Cost											
Flexibility											

Figure 2: S&R questionnaire

2 Manufacturing Strategy Index (MSI)

MSI is described as the method of detection of the preferable strategy type. The method implies the key elements of RAL model and derives the proportions of importance between Quality, Cost, Time and Flexibility.

The MSI questionnaire uses pairwise comparison of criteria on a scale reaching from 9 on the left hand side to 9 on the right hand side, with a neutral choice of 1 in the between the two

criteria. The full questionnaire consists of 6 top-level questions and 36 detailed questions. For this case study however the MSI survey was limited to the 6 top-level questions.

KUSTANNUKSET (C)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	LAATU (Q)
KUSTANNUKSET (C)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	TOIMITUS (D)
KUSTANNUKSET (C)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	JOUSTAVUUS (F)
LAATU (Q)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	TOIMITUS (D)
LAATU (Q)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	JOUSTAVUUS (F)
TOIMITUS (D)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	JOUSTAVUUS (F)

Figure 3: MSI top-level questions

To evaluate the answered MSI questionnaires, a model was built using the Expert Choice software. With this model, the priority weights of the criteria were calculated depending on the answers given by the company informants. With the priority weights at hand it is then possible to detect a company's strategy type according to the typology by Miles & Snow (1978), which defines the Prospector, Analyzer, Defender and Reactor business strategy types. For example a high priority weight would be an indicator for a Prospector strategy.

RESULTS AND ANALYSIS

1 Sense and Respond

The Sense and Respond questionnaire included 32 attributes within Quality (Q), Cost (C), Time (T) and Flexibility (F). However, the attributes for operation strategies were not equal. Attributes were divided as follows: Q: ten, C: eight, T: eight and F: seven. Since the questionnaire was custom made in advance, no attributes were equally compiled. In other words, no attributes were left out of the calculations. Hence, this may affect the results.

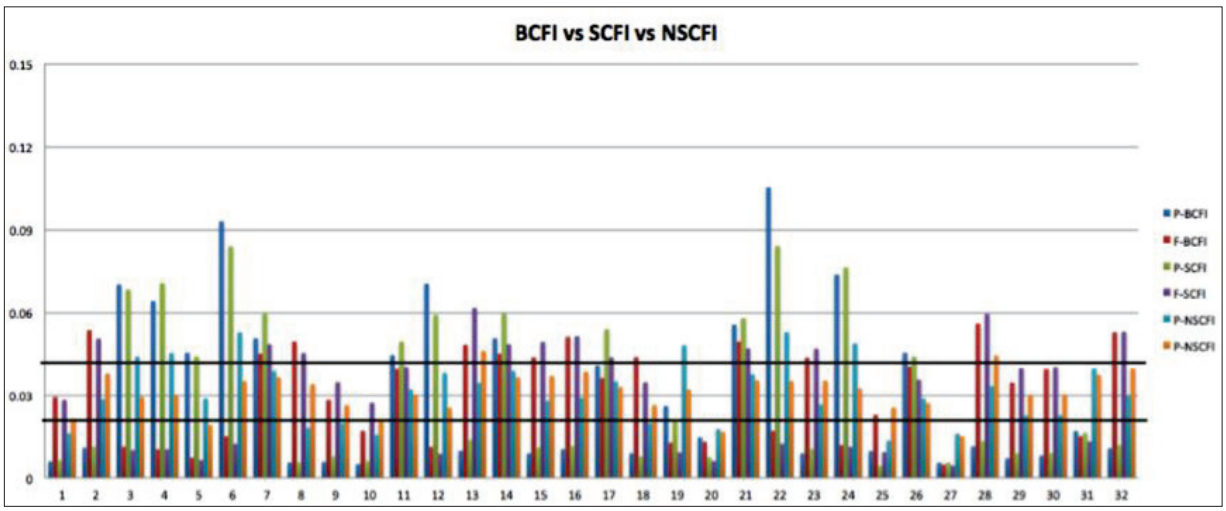


Figure 4: Results of BCFI, SCFI and NSCFI

Figure 4 shows the collected Sense and Respond data from the case company. This is an illustration of the trend for how critical factors change and develop directions. The Figure shows the calculated S&R results of past and future values using BCFI, SCFI and NSCFI models. The range of the attributes are divided into three parts; over resourced, balanced and under resourced. Therefore, if an attribute falls between the range of ⅓ and ⅔ of the average resource level, it is considered balanced. An attribute that is in the range lower than ⅓, is considered under resourced. In this case, average level is 100%/32=3,125%, which means that the judging values are 2,083% and 4,167%. This means, that any attribute lower than 2,083% is under resourced and any attribute higher than 4,167% is over resourced. The resource levels are marked with black lines in Figure 4.

A comparison of past and future BCFI, SCFI and NSCFI can be seen in Table 5. In Table 5, the attributes were analyzed one by one.

Table 5: Comparison of Past and Future BCFI, SCFI and NSCFI

Attribute	P-BCFI	F-BCFI	Trend	P-SCFI	F-SCFI	Trend	P-NSCFI	F-NSCFI	Trend
1	Under	Good	Better	Under	Good	Better	Under	Good	Better
2	Under	Over	Worse	Under	Over	Worse	Good	Good	-
3	Over	Under	Worse	Over	Under	Worse	Over	Good	Better
4	Over	Under	Worse	Over	Under	Worse	Over	Good	Better
5	Over	Under	Worse	Over	Under	Worse	Good	Under	Worse
6	Over	Under	Worse	Over	Under	Worse	Over	Good	Better
7	Over	Over	Better	Over	Over	Better	Good	Good	-
8	Under	Over	Better	Under	Over	Better	Under	Good	Better
9	Under	Good	Better	Under	Good	Better	Under	Good	Better
10	Under	Under	Better	Under	Good	Better	Under	Under	Better
11	Over	Good	Better	Over	Good	Better	Good	Good	-
12	Over	Under	Worse	Over	Under	Worse	Good	Good	-
13	Under	Over	Better	Under	Over	Better	Good	Over	Worse
14	Over	Over	Better	Over	Over	Better	Good	Good	-
15	Under	Over	Better	Under	Over	Better	Good	Good	-
16	Under	Over	Better	Under	Over	Better	Good	Good	-
17	Good	Good	-	Over	Over	Better	Good	Good	-
18	Under	Over	Better	Under	Good	Better	Under	Good	Better
19	Good	Under	Worse	Under	Under	Worse	Over	Good	Better
20	Under	Under	Worse	Under	Under	Worse	Under	Under	Worse
21	Over	Over	Better	Over	Over	Better	Good	Good	-
22	Over	Under	Worse	Over	Under	Worse	Over	Good	Better
23	Under	Over	Better	Under	Over	Better	Good	Good	-
24	Over	Under	Worse	Over	Under	Worse	Over	Good	Better
25	Under	Good	Better	Under	Under	Better	Under	Good	Better
26	Over	Good	Better	Over	Good	Better	Good	Good	-
27	Under	Under	Worse	Under	Under	Worse	Under	Under	Worse
28	Under	Over	Better	Under	Over	Better	Good	Over	Worse
29	Under	Good	Better	Under	Good	Better	Good	Good	-
30	Under	Good	Better	Under	Good	Better	Good	Good	-
31	Under	Under	Worse	Under	Under	Worse	Good	Good	-
32	Under	Over	Better	Under	Over	Better	Good	Good	-

Table 5 shows how the attributes change from before economic crisis to during economic crisis. There is comparison of results of past and future values using three different S&R models (CFI, BCFI and SCFI) which are based on analysis of 32 attributes one by one. The trend clearly shows how any specific attribute alters from past to future. When the value of an attribute in both before and during are good, the trend is considered to be unchanged and marked with "-". Values, which change from good to other, will show that the trend is worse. However, if values change from other to good, the trend is better. When values are either lower or higher, it is still recognizable to determine their direction. For instance, if two values are over resourced and the latter value is lower, then the direction is better and vice versa.

When comparing the results, a summary can be made that all values are valid. Looking at the trends for BCFI and SCFI, most of the attributes are marked as "Better" while NSCFI have almost the same amount of attributes marked with "Better" and "Same". The trend for before and during NSCFI is showing good results. Many attributes have shown 0 index values the reason behind this is zero standard deviation in the collected data, which is expected commonly. So from the 0 index value no real situation can be analyzed. But still the original CFI model is considered to be a benchmark to interpret the critical factors.

The BCFI and SCFI proved to be helpful for solving above mentioned problem and more interpretations can be made from the results. The addition of one to the standard deviation by the developer of BCFI, which results in standard deviation becoming one, avoiding the zero SD. For SCFI using root mean square to avoid zero standard deviation is enough. These formulas are shown in Figure 5 below.

Name	Model
CFI	$CFI = \frac{Std\{experience\} \cdot Std\{expectation\}}{Imprtance\ index \cdot Gap\ index \cdot Development\ index}$
BCFI	$SD\ Expectation\ index = \frac{Std\{expectation\}}{10} + 1$ $SD\ Experience index = \frac{Std\{experience\}}{10} + 1$ $BCFI = \frac{SD\ Expectation\ index \cdot SD\ Experience index \cdot Performance index}{Imprtance\ index \cdot Gap\ index \cdot Development\ index}$
SCFI	$SCFI = \frac{\sqrt{\frac{1}{n} \cdot \sum_{1}^{n} [experience(i) - 1]^2} \cdot \sqrt{\frac{1}{n} \cdot \sum_{1}^{n} [expectation(i) - 10]^2} \cdot Performance index}{Imprtance index \cdot Gap\ index \cdot Development\ index}$

Figure 5: CFI, BCFI and SCFI formula

The inconsistent results in CFI than BCFI and SCFI shows that critical factor index as the benchmark cannot be considered correct in real case study analysis. So, the derived formulas such as BCFI and SCFI are alternative options. This case study analysis also showed that the results of BCFI and SCFI are more consistent than the CFIs. From discussion with the case company inconsistent results can be verified which one is right and which one is wrong.

The feedback and discussion from the case company can verify if one is evaluating right. However, in this case the feedback from the case company is confidential.

2 Manufacturing Strategy Index (MSI)

Two informants from the case company answered the two questionnaires for MSI. When answering the questionnaire, the informants have marked the situations before the economic crisis of 2008/2009 with a green color. The situation during the crisis is marked with a red color. Informant number one did not provide answers concerning the situation before the crisis, due to the fact that his employment in the case company started after the crisis. Hence, informant number one had not been working there long enough to access the situation before crisis.

Table 6: MSI answered by Informant 1

KUSTANNUKSET (C)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	LAATU (Q)
KUSTANNUKSET (C)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	TOIMITUS (D)
KUSTANNUKSET (C)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	JOUSTAVUUS (F)
LAATU (Q)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	TOIMITUS (D)
LAATU (Q)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	JOUSTAVUUS (F)
TOIMITUS (D)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	JOUSTAVUUS (F)

Table 7: MSI answered by Informant 2

KUSTANNUKSET (C)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	LAATU (Q)
KUSTANNUKSET (C)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	TOIMITUS (D)
KUSTANNUKSET (C)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	JOUSTAVUUS (F)
LAATU (Q)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	TOIMITUS (D)
LAATU (Q)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	JOUSTAVUUS (F)
TOIMITUS (D)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	JOUSTAVUUS (F)

As the tables show, there can be seen which strategy types the case company has been focusing on before and during economic crisis. The strategy type derives the proportions of importance between Quality (Laatu), Cost (Kustannukset), Delivery (Toimitus), and Flexibility (Joustavuus). The answers of the informants are quite similar when comparing the answers during the economic crisis. Since only informant number two could state the importance of Q, C, D and F before economic crisis, there is no other answer that could be compared with it. Each result displays a high priority on Quality, followed by Delivery and Flexibility while putting little value on Cost. This order is consistent in between both Informants and in case of Informant 2 it even remains the same for the assessment before and during the economic crisis.

The MSI results shows that the case company, both before and during economic crisis, focused on the importance of Quality as their main strategy type. When calculating the integrated values, a weight of 1⁄3 was given to Informant 1 and 2⁄3 was given to Informant 2. It was decided to put more weight on Informant 2 due to the facts that he provided a full set of data and had more working experience in the case company compared to Informant 1. In the case of Informant 1, who was not able to assess the situation before the economic crisis, missing data was left blank and calculations for integration were adapted. Therefore, there is a 100% weight on Informant 2 for integrated P-MSI values.

Table 8: Integrated values of MSI

	Integrated values			
	Q	C	D	F
P-MSI	0,529	0,068	0,254	0,150
F-MSI	0,550	0,068	0,247	0,136

Table 8 shows the integrated values of the MSI results. Past Manufacturing Index for Q, C, D, and F, should have a value equal to one and Future Manufacturing Index for the same proportions should as well have a value equal to one. As can be seen in Table 9, both P-MSI and F-MSI have the same importance for the proportions, only some small changes in the values.

Table 9: Strategy type Prospector, Analyzer and Defender

	P	A	D
P-MSI	0,947	0,961	0,902
F-MSI	0,950	0,916	0,906

Considering the strategy type regarding to MSI-results, there can be seen that Analyzer is the strongest strategy type before economic crisis. However, the strategy type changes during the economic crisis from Analyzer to Prospector.

3 SCA

The integrated MSI- and S&R-results were put into the SCA-calculation. The sum check was true for each variable. SCA values shall be between 0 and 1. Values close to or greater than 0.97 can be considered as high. Values reaching from 0.93-0.97 are further referred to as “medium high” and values <0.93 as “low” values.

Table 10: Sum check and P, A, D results for SCA

	Q	C	T	F	Check	P	A	D
P-MSI	0,484	0,071	0,283	0,162	TRUE	0,941	0,896	0,898
F-MSI	0,550	0,068	0,247	0,136	TRUE	0,950	0,916	0,906
P-BCFI	0,275	0,275	0,055	0,394	TRUE	0,908	0,902	0,908
F-BCFI	0,298	0,298	0,326	0,078	TRUE	0,935	0,973	0,935
P-SCFI	0,314	0,297	0,067	0,322	TRUE	0,914	0,893	0,912
F-SCFI	0,303	0,286	0,354	0,056	TRUE	0,942	0,984	0,941
P-NSCFI	0,264	0,250	0,217	0,268	TRUE	0,906	0,986	0,904
F-NSCFI	0,261	0,247	0,304	0,188	TRUE	0,913	0,985	0,912

SCA calculations derived from the MSI questionnaire (indicated with green background color) resulted in medium high values for the Prospector strategy and low values for the other groups, both for past- and future-orientation. The tendency in the MSI-based SCA values towards the Prospector group is supported by the MSI priority weights, which have a high emphasis on

quality. High priority weights on quality are typical for a Prospector strategy with quality being a crucial point for this type of strategy (Golovko 2012: 14).
Calculations based on the S&R questionnaire regarding the past orientation resulted in low values for all strategy types, except P-NSCFI for Analyzer. Concerning the future orientation, we find high values for Analyzer and medium high to low values for the Analyzer and Defender groups. These results would indicate that our case company has turned from a former strategy that was not clearly defined towards a highly Analyzer characterized business strategy.

Table 11: Angle results and MAPE, RMSE and MAD values

α	β	γ	α Degree	β Degree	γ Degree	Check	MAPE	RMSE	MAD
1,037	1,025	1,079	59,444	58,714	61,842	TRUE			
1,023	1,055	1,064	58,615	60,430	60,955	TRUE			
1,045	1,051	1,045	59,881	60,240	59,879	TRUE	0,935	0,958	0,968
1,059	1,024	1,059	60,657	58,687	60,656	TRUE	0,931	0,955	0,965
1,040	1,060	1,042	59,577	60,737	59,686	TRUE	0,928	0,951	0,965
1,060	1,021	1,061	60,712	58,521	60,767	TRUE	0,930	0,952	0,964
1,071	0,998	1,073	61,369	57,165	61,466	TRUE	0,935	0,958	0,968
1,069	1,003	1,070	61,226	57,465	61,309	TRUE	0,901	0,933	0,951

These angles more correctly reflect the way of business strategy implementation. The sum check was true for all angles. Calculations may have the outcome that the company has to change its operations strategy. Using SCA-method can bring stability, flexibility, and sustainability for the organization and enlarges its performance and competitiveness. With the result from this research the case company can forecast their future strategy and business performance.

4 Business environment and study expectations

In this research BCFI method was used to find critical attributes for a new start up business of a global company. The purpose was to identify the development actions needed and to prioritize resources for these measures. The second goal for the study was to recognize attributes with unclear goal setting and to emphasize the need for these to be clarified by the management.

The organization in focus is under change from R&D project to business process. The goal of the study was to collect expectations of different organizational groups and to highlight attributes that are considered as critical for the business development. These findings are taken into account when making decisions for strategic actions to follow.

In the core of the business is a material handling service which is executed by delivering a special tailor-made automated storage device for the customer company. Device is at the customer's disposal against fixed monthly fee that includes the storage system, support for the service and software development. The research covered supply department that manages platform, procurement, production and delivery activities.

FINDINGS

The questionnaire included 32 questions covering all supply activities and management attributes. Moreover some of the questions aimed to show up expectations about how the supply organization should support research and development. In this case the supply team cannot focus only on process development, but has a role to support R&D activities as well.
Nine questionnaires were sent and eight of them were responded. The data was handled in three groups, based on the organizational position of the respondent. Three answers were received from the board members, two from supply management and three from team leaders of other activities inside the business. When estimating the final actions results from all the three groups were taken into account.

Table 12: Attributes in questionnaire

Question Category	Atrribute number	Attribute
Production and material flow	1	Assembling functions are effective with minimized waste in the process
	2	Quality of assembling is homogenous and modules are compatible
	3	Asset risk of the material flow is being controlled and reported regularly
	4	The supply chain is quickly able to react on changes in market demand
	5	The needs of R&D are well considered within the production process
	6	Current receivables are on an optimized level when compared to deliveries
	7	Risks concerning stock and assets within material flow are under good control
Product platform	8	There is always available reliable cost information about the product
	9	New features developed by the R&D are utilised rapidly
	10	The product cost structure and it´s development are transparent
	11	Including new features to the manufactured product is cost-effective
	12	Production version and R&D version are clearly separated when sustaining delivery ability
Delivery and mounting process	13	Ability to deliver the system for test run within one working day is the target
	14	System deliveries are carried out precisely on the day confirmed for the customer
	15	Delivery process is budgeted and the budget is controlled in order to ensure cost efficiency
	16	The company brand is visible during each delivery process
	17	Mounting a system is managed in accordance with the company brand
	18	Delivery ability of the product covers also export markets
Support for product development	19	Supply actively joins developing the product
	20	Assembly applies the system in production
	21	Company's own production is used as a reference and a tool for sales activity
	22	Supply takes part in developing process control tools for the product
	23	Information security is taken into account within the scope of all operations
Supply management	24	Safety at work is strongly emphasized and kept in mind at all levels of production
	25	Communication between R&D and production works well
	26	Information about future deliveries is actively spread in order to maintain operational readiness
	27	Activities are well organized with clear definitions about employee responsibilities and authorities.
	28	The organisation values process discipline, only serious causes justify violating the process structure
	29	The information produced is reliable
	30	Professional skills of the employees are maintained and improved actively in accordance to job descriptions
	31	The company's ERP guarantees good support for the process
	32	Customer needs and wishes are thoroughly taken into consideration throughout the delivery

1 Critical attributes

The main findings of the research is related to cost and asset control. When starting a new business, the big challenge is how to make the right structural decisions to enable the expected growth. Three top critical attributes concerned risk management in stock and asset control. BCFI indicated these issues critical in both board and supply management results. In the results of the

team leaders' group the status was more unclear, but in overall results these attributes were considered critical.

In the results it can be seen that the board pictures the startup already in a bigger size. Expectations to grow are on a high level. With the current low volumes asset risks are not significant and there is a risk that the operating strategy does not focus on the process structure as closely as required. In this case growth is most likely to happen and the scale can be altered in a very short time. Quick change with low functionality of process operations might block the growth. Practically this sets a need to build consumption based material flow and process with good tools for parameter control to direct activities effectively.

2 Unclear attributes

Most significant finding within unclear attributes was that the organization did not have a unified vision about the schedule of making the business ready for export markets. This issue rose up in the discussion when the results were presented to board. This can be seen directly from the BCFI index values as well.

Other issues within unclear findings where related to product lifecycle and process parameter management activities. This means that the organization needs to clarify its' methods and processes concerning goal communication and production version management. When ramping up a business it is important to keep the product and the process updated matching the goal while simultaneously ready to support the changes needed.

Table 13: BCFI results

	BCFI Index			BCFI Ranking inside the group			Attribute Critical Level		
Attribute Number	Top management	Supply Management	Team leaders	Top management	Supply Management	Team leaders	Top management	Supply Management	Team leaders
1	1,175	1,110	1,509	4	5	27	Rather critical	Rather critical	Unclear
2	1,823	1,508	1,498	29	30	25	Unclear	**Very unclear**	**Rather unclear**
3	1,150	0,985	1,234	3	2	6	**Critical**	**Critical**	Rather critical
4	1,782	1,220	1,350	26	16	17	**Rather unclear**	Neutral	Neutral
5	1,195	1,343	1,585	5	24	30	Rather critical	**Rather unclear**	**Very unclear**
6	1,121	1,178	1,240	2	10	7	**Critical**	**Quite OK**	More critical than unclear
7	1,102	1,141	1,266	1	9	9	**Critical**	More critical than unclear	Unclear
8	1,821	1,332	1,183	28	23	4	Unclear	More unclear than clear	Rather critical
9	1,798	1,072	1,293	27	3	11	Unclear	**Critical**	**Quite OK**
10	1,469	1,074	1,306	19	4	13	Neutral	Rather critical	Neutral
11	1,316	1,195	1,481	11	14	24	**Quite OK**	Neutral	**Rather unclear**
12	2,102	1,327	1,311	32	22	14	**Very unclear**	More unclear than clear	Neutral
13	1,280	1,528	1,895	8	31	32	More critical than unclear	**Very unclear**	**Very unclear**
14	1,852	1,179	1,796	30	11	31	**Very unclear**	**Quite OK**	**Very unclear**
15	1,319	0,976	1,173	12	1	3	**Quite OK**	**Critical**	**Critical**
16	1,458	1,110	1,464	16	7	22	Neutral	More critical than unclear	More unclear than clear
17	1,672	1,429	1,128	24	28	2	**Rather unclear**	Unclear	**Critical**
18	**1,652**	**1,185**	0,781	22	**12**	1	More unclear than clear	**Quite OK**	**Critical**
19	1,252	1,236	1,260	7	18	8	More critical than unclear	Neutral	More critical than unclear
20	1,407	1,110	1,320	15	6	16	Neutral	Rather critical	Neutral
21	1,715	1,402	1,439	25	27	21	**Rather unclear**	Unclear	More unclear than clear
22	1,198	1,399	1,551	6	26	29	Rather critical	**Rather unclear**	Unclear
23	1,550	1,192	1,371	21	13	18	More unclear than clear	Neutral	Neutral
24	1,397	1,437	1,214	13	29	5	Neutral	Unclear	Rather critical
25	1,481	1,231	1,536	20	17	28	Neutral	Neutral	Unclear
26	1,910	1,272	1,297	31	20	12	**Very unclear**	Neutral	**Quite OK**
27	1,467	1,211	1,409	18	15	19	Neutral	Neutral	Neutral
28	1,299	1,284	1,465	10	21	23	**Quite OK**	More unclear than clear	More unclear than clear
29	1,652	1,389	1,414	23	25	20	More unclear than clear	**Rather unclear**	Neutral
30	1,405	1,240	1,266	14	19	10	Neutral	Neutral	**Quite OK**
31	1,463	1,124	1,315	17	8	15	Neutral	More critical than unclear	Neutral
32	1,292	1,631	1,501	9	32	26	More critical than unclear	**Very unclear**	**Rather unclear**

CONCLUSIONS

Results were used for strategic planning for the year 2013. The main focus now is to prepare processes for profitable growth to be ready for the expected period of growing fast. Actions are taken to improve process control tools and accuracy of asset management. The target is to create consumption based material flow with an agile parameter control.

Other important finding was the need of common understanding about the right timing when to start piloting export cases. Before starting to prepare going abroad maturity of operating processes and device have to be developed to a good level. If maturity is too low, the risk of loosing control of costs begins to grow too high. Basing on this study, the board has now generated a strategic plan and a realistic schedule about when to aim towards the export markets. This study has shown the value of BCFI method in investigating the status of an organization. With this method it is possible to produce numeric information about how well communication functions within organizational hierarchy or between teams. Also the level of understanding strategic communication and the way the different actions are linked to it in order to achieve the common goal can be measured.

Table 14: Action categories for attributes

Atrribute number	Attribute	Actions needes
1	Assembling functions are effective with minimized waste in the process	Make a plan about actions needed
2	Quality of assembling is homogenous and modules are compatible	Define targets as soon as possible
3	Asset risk of the material flow is being controlled and reported regularly	Make a plan about actions needed
4	The supply chain is quickly able to react on changes in market demand	No actions needed
5	The needs of R&D are well considered within the production process	Describe actions needed
6	Current receivables are on an optimized level when compared to deliveries	Make a plan about actions needed
7	Risks concerning stock and assets within material flow are under good control	Make a plan about actions needed
8	There is always available reliable cost information about the product	Define targets as soon as possible
9	New features developed by the R&D are utilised rapidly	Describe actions needed
10	The product cost structure and it´s development are transparent	No actions needed
11	Including new features to the manufactured product is cost-effective	No actions needed
12	Production version and R&D version are clearly separated when sustaining delivery ability	Define targets as soon as possible
13	Ability to deliver the system for test run within one working day is the target	Describe actions needed
14	System deliveries are carried out precisely on the day confirmed for the customer	Define targets as soon as possible
15	Delivery process is budgeted and the budget is controlled in order to ensure cost efficiency	Make a plan about actions needed
16	The company brand is visible during each delivery process	No actions needed
17	Mounting a system is managed in accordance with the company brand	Describe actions needed
18	Delivery ability of the product covers also export markets	Describe actions needed
19	Supply actively joins developing the product	Describe actions needed
20	Assembly applies the system in production	No actions needed
21	Company's own production is used as a reference and a tool for sales activity	Define targets as soon as possible
22	Supply takes part in developing process control tools for the product	Describe actions needed
23	Information security is taken into account within the scope of all operations	No actions needed
24	Safety at work is strongly emphasized and kept in mind at all levels of production	No actions needed
25	Communication between R&D and production works well	No actions needed
26	Information about future deliveries is actively spread in order to maintain operational readiness	Define targets as soon as possible
27	Activities are well organized with clear definitions about employee responsibilities and authorities.	No actions needed
28	The organisation values process discipline, only serious causes justify violating the process structure	No actions needed
29	The information produced is reliable	No actions needed
30	Professional skills of the employees are maintained and improved actively in accordance to job descriptions	No actions needed
31	The company's ERP guarantees good support for the process	No actions needed
32	Customer needs and wishes are thoroughly taken into consideration throughout the delivery	Describe actions needed

DISCUSSION

This study examined a case company's behavior towards operational strategy before and during the economic crisis in 2008–2009. The study was analyzed by the corresponding angles of the strategic triangles. Along with the study, a new S&R model, named NSCFI, was developed based on previous models. To verify a case study of this character, it is essential to acquire proper feedback from the case company in order to ensure the results.

It is vital for managers to have knowledge of their company's operational strategy. By understanding operational strategy, companies will allow themselves to make correct decisions that will have a positive influence on the companies' long term capabilities (Slack and Lewis, 2002). The method presented in this paper will help organization leaders to gain control over the strategic focus. Research shows, that this study has given the best validation yet known for NSCFI model. Hence, it is significant to prove this model in a larger scale of case studies.

The results indicate that the case company went from having a somewhat diffuse approach on strategy to a clear and profitable approach. If companies do not have a common vision for strategy, it might mean that resources are misspent. Before the economic crisis, the company's strategy was scattered between Prospector, Defender and Analyzer types of strategy. However, the Analyzer strategy type had the strongest numerical values both before and during the economic crisis. On the other hand, towards the crisis the Analyzer strategy type emerged clearer than any other. In other words, the company changed its strategy focus into one unified orientation where a balance between quality, cost and time was achieved (Miles and Snow, 1978).

It is important to remember the fact that one of the informants was only able to give insight on the situation during the economic crisis. Furthermore, the Sense and Respond questionnaire consisted of an uneven amount of attributes for each proportion. A last limitation is the relatively high inconsistency ratio for one of the informants' answers in the MSI questionnaire. All these factors, along with a larger number of informants could have an impact on the result of this case study.

ACKNOWLEDGEMENTS

The authors wish to acknowledge Prof. Josu Takala and Assoc. Prof. Liu Yang for their valuable comments and guidance for making this paper to happen. The authors also would like to thank Alexander Mäntylä (v98949@student.uwasa.fi), Patricia Kronman (v98945@student.uwasa.fi), Andreas Kreuzer (v98944@student.uwasa.fi) and Afnan Zafar (v98960@student.uwasa.fi) for their remarkable effort in analyzing and interpreting the data and preparing the report.

REFERENCES

1. Liu, Y., Wu, Q., Zhao, S. & Takala, J., 2011. *Operations Strategy Optimization Based on Developed Sense and Respond Methodology.* Kitakyushu, Japan, Proceedings of the 8th International Conference on Innovation & Management.
2. Takala, J., Liu, Y., Feng, B. & Yang, W.S., 2013. *Analytical Evaluation of Sustainable Competitive Advantage.* Moscow, Russia, IFAC Conference on Manufacturing Modelling, Management and Control.
3. Johnson, G., Scholes, K. and Whittington, R. (2005), "Exploring Corporate Strategy*"* Prentice Hall, Harlow, UK.
4. Miles, R. & Snow, C., (1978), Organizational strategy, structure, and process. McGraw-Hill, New York, NY.
5. Mintzberg, H., Ahlstrand, B. W. & Lampel, J., (1998), "Strategy safari: A guided tour through the wilds of strategic management". http://cws.cengage.co.uk/barnes/students/sample_ch/ch2.pdf (accessed 10 January 2013).
6. Skinner, W. (1986), "The productivity paradox" *Harvard Business Review*, Vol. 64 No. 4, pp.55-59
7. Slack, N. and Lewis, M. (2002), "Operations Strategy", Prentice-Hall, Edinburgh.
8. Golovko, Ivan (2012). *Directions of a Company's Preferable Strategy Type by Sense & Respond Methodology.* Vaasa: University of Vaasa.
9. Miles, R.E., Snow, C.C., (1978). *Organizational strategy, structure and process.* New York: McGraw-Hill.
   Ranta J. M. & Takala J. A Holistic Method for Finding out Critical Feature of Industry Maintenance Services[J]. International Journal of Services and Standards, 2007, 3(3): 312-325
10. Golovko, Ivan (2012). *Directions of a Company's Preferable Strategy Type by Sense & Respond Methodology.* Vaasa: University of Vaasa.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

MINING IT BUSINESS TEXTS TO ANALYZE TECHNOLOGY TRENDS

Sumali J. Conlon, Department of MIS, School of Business Administration, University of Mississippi University, USA
Email: sconlon@bus.olemiss.edu

Lakisha L. Simmons, Department of Information Systems Management, School of Business Administration, Belmont University
Email: lakisha.simmons@belmont.edu

ABSTRACT

Purpose: *The aim of this research is to use a text mining technique to analyze IT business documents semi-automatically to find information about, for example, the evolution of products/services firms produced over time, what new businesses they were interested in investing in, how they improved their products, and what other businesses they merged with.*
Design/methodology/approach: *We analyze online text documents semi-automatically using natural language processing (NLP) techniques such as collocation analysis, sub-language analysis, and information extraction. These techniques are used on a collections of business documents, accumulated over a long period of time, to yield important insights.*
Findings: *Using a huge amount of documents collected in a long period of time, we are able to find business trends of the IT businesses.*
Research limitations/implications: *The documents we use are still limited, for future research, more documents and new techniques should be applied.*
Practical implications: *This research can reveal, for example, the evolution of products/services firms produced over time, what new businesses they were interested in investing in, how they improved their products, and what other businesses they merged with. This information can help to trace firms' strategic evolution. In addition, financial analysts frequently get information from business reports in order to evaluate the financial position of the companies they are interested in. An analysis of how information in financial documents evolved over time can therefore help in studying changes in a firm's financial health.*
Social implications: *Similar techniques can also be applied with other types of documents in other domains such as social sciences to understand the social issues better.*
Originality/value: *Much research has been done using text analysis techniques in several areas such analyzing product reviews, clustering data, etc. However, this research analyzes business data to study business trend which has not been done earlier.*

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

A VALUE ASSESSMENT MODEL FOR SUSTAINTABLE SMART CITIES

June Wei, College of Business, University of West Florida, Florida, USA
Email: jwei@uwf.edu

ABSTRACT

A smart city applies information and communication technologies (ICTs) to planning, designing, building, and operating city infrastructures in order to improve life quality and economy. It covers many aspects in a city such as utility, public transportation, education, healthcare, entertainment, and city governances via using ICTs. Benefits that a smart city can offer include resource optimization on identification of mismanagement, quick disaster recovery and fast emergency responses via real-time data evaluation, better service quality to citizens and organizations, and efficient city administration.

Motivated by the apparent lack of literatures in the area of an exploratory study on value assessment in building smart cities, this paper aims at developing a value assessment model for smart cities (VAMSC) based on value theory. Specifically, it first developed a theoretical model for assessing smart cities value based on value theory and mean-end analysis method, which includes means and fundamental value objectives. The means objectives are developed based on a strategic value assessment model and the fundamental objectives are based on an engagement assessment model. This assessment model includes four levels: Level 1 - smart information and communication infrastructure (objectives in Privacy, Security, Social Networking, and Technology such as Internet of Things, RFID, and Cloud Computing); Level 2 - smart organization infrastructure (objectives in Education, Transportation, Utility & Sanitation, Healthcare, and Social & Entertainment); Level 3 - smart governmental infrastructure (objectives in Economy, Legal & Law, and Policy & Regulation); and Level 4 - smart environmental infrastructure (objectives in Green Environment and Social Harmony).

Second, a survey is developed to measure these mean and fundamental objectives. Data was collected from 283 subjects using the stratified sampling method. Multivariate statistical analysis such as factor analysis was used to analyze data. The findings show that a 6-factor instrument that measures means objectives and 4-factor measures fundamental objectives. Third, a relative-weighted assessment method was proposed to assess the value level of smart cities based on the results derived from data analysis. Finally, recommendations and guidelines are presented to assist city administers and decision making for building and operating a smart city. The results of this research will provide strategies on how to transform cities into smart cities by accelerating the adoption of smart technologies and smart systems. The paper also will assist city administrators and top level managers when they make decisions on building a smart city and to improve people's living quality in a city. Managerial and practical implications are also presented.

One limitation of this research is that subjects were recruited from one country. With the advanced ICTs, a smart city moves to globalization to deliver high quality services to citizens and organizations. A smart city across countries based on global ICTs creates an even high level of value. The future research will develop a cross-cultural value assessment system for building and operating cross-cultural smart cities for global users by considering risks inherited from cultural differences.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

MOBILE ORDERING SYSTEM STRUCTURE AND DEMAND ANALYSIS

Kuang-Husn Shih, President, Toko University, No.51, Sec. 2, Syuefu Rd., Puzih City, Chiayi County 61363, Taiwan
E-mail: shihsteve33@gmail.com

Fu-Ju Yang, Department of Banking & Finance,Chinese Culture University, 55, Hwa-Kang Road, Yang-Ming-Shan,Taipei 11114, Taiwan
E-mail: fuju@faculty.pccu.edu.tw

Ching-Wen Lin, Department of International Business Administration,Chinese Culture University, 55, Hwa-Kang Road, Yang-Ming-Shan,Taipei 11114, Taiwan
E-mail: Lincw@niu.edu.tw

Ching-Yi Lin, Graduate Institute of International Business Administration, Chinese Culture University,55, Hwa-Kang Road, Yang-Ming-Shan, Taipei, 11114, Taiwan
E-mail: cigaw2000@gmail.com

ABSTRACT

E-service has changed securities market trading patterns. At present, securities dealers mainly provide an internet ordering mode and mobile ordering services, while past trade patterns are mostly based on Internet ordering as the main trading mode. With increasingly powerful mobile phone functions and stable development of the current 3G systems, the willingness of investors to adopt has significantly increased. Hence, this study adopted the Analytic Network Process (ANP) to evaluate the demand on the mobile ordering services of securities dealers to learn about the mobile ordering structure, demands, and concerns of securities dealers.

The study expects to explore the service contents and switching costs of the mobile ordering structure and compare factor importance and mutual influence of service contents and switching costs. The findings can be provided to the system development industry as a reference. It is expected to allow system developers to better understand the demands of securities dealers in the mobile ordering service structure in the future.

Keywords: Mobile Ordering, CRM (Customer Relation Management), Switching Costs, Analytic Network Process (ANP)

INTRODUCTION

Huang (2009) proposed that the rise of the network has delivered immediacy and convenience, as mobile finances can efficiently provide financial services by providing securities dealer customers with complete investment tools, investment information, and customer services. According to Wen et al. (2009) indicated that flow of information uses the Internet as a circulation pipeline, where mobile phone services play a very important role, as a website can provide 24-hour services online. Therefore, the use of websites for finance and investment is the current trend. Contemporary mobile Internet service is not subject to environmental restrictions or time limits, and more importantly, the users do not need to rely on a computer to enter the virtual world of the Internet. With the continuous advancements of mobile communication equipment, mobile Internet service is gradually accepted and recognized as important by investors. Learning historical data, customer background, investment preferences, and other information of the customers, according to the system information, allows enterprises to provide customized services or commodities to customers and build good relationships. Shih (2010) pointed out that the mobile financial and investment services can create a unique service for customers.

With the rapid maturity of the application environments of mobile platforms, securities firms have become gradually concerned about the mobile ordering market. In response to such a developing trend, securities dealers are actively building and perfecting mobile ordering platforms and importing the CA (Certification Authority) certificate mechanism to expand the range of applications of electronic ordering from desktop computers to smart phones. The securities industry should consider how to build a mobile ordering system for better operating performance, which simultaneously considers customer switching costs, in order to attract more customers to mobile ordering. This study plans to collect the mobile ordering service status information, as provided by securities dealers, to explore the significance and relevance of the factors affecting mobile ordering as reference indicators for planning mobile ordering services of securities dealers.

LITERATURE REVIEW

1. Mobile communications system

The mobile ordering system used in this study is a 3G wireless communication system. The currently designed software of securities dealers is aimed at 3G systems, as they are faster and more stable than 2G systems in transmission. The range of a 3G system is wide; therefore, the 3G system is believed to be more suitable by telecommunications companies for mobile ordering systems.

2. Switching Costs

Constantinides (2002) argued that there are some extra costs when switching from e-commerce to mobile commerce, and the costs of mobile commerce is higher than e-commerce. Kim (2004), Grzybowski (2008), Maicas (2008) and Maicas (2009) proposed that switching costs exist in various products and services, including airlines, financial services, and mobile telecommunications. The reason for the switching costs is the customer intention to change suppliers and the cause of switching is reduced satisfaction and loyalty to

the supplier. Porter (1980) argued that, the cost of changing from an original supplier to a new supplier can be regarded as "one-time switching costs". Mattews and Murray (2007) pointed out when switching suppliers, the switching costs consist of financial and non-financial costs, the switching of service relationships will result in switching obstacles. Meanwhile, service providers may create customer inertia by using switching costs to maintain the service relationship between the consumer and the original supplier to obtain more benefits.

According to Matthews and Murray (2007), in addition to the financial and non-financial costs, consumers are faced with uncertainties in time, psychology, and emotions, as brought when switching to a new service provider. As suggested by Burnham (2003) and Cheng (2007), switching costs is a type of one-time costs generated in the face of supplier switching. Hsin and Su (2009) argued that switching costs include time, money, and energy. Klemperer (1987), Klemperer (1995), Matthews and Murray (2007), and Burnham (2003) pointed out that, switching costs can be divided into Transaction costs, Learning costs, and Contractual costs. Switching costs refer to the perceived potential risks, lost revenue, and consumed energy when switching suppliers. The existence of switching costs grants enterprises with stronger market power to allow them to obtain higher prices in the market, reduce product or service quality, and establish entry barriers, thus, gaining abnormal returns.

3. Customer Relation Management (CRM)

The financial services industry can be roughly divided into banking, insurance, securities, and other industries. In the securities industry, customer transactions are characterized by the highest repeated purchase rate; therefore, excellent CRM systems can bring excellent financial performance to the enterprises. Therefore, the introduction of CRM is regarded as a trend in the financial industries. The mobile ordering system can be set according to the demands of investors, meaning the investor mobile ordering system has a high level of customization. CRM is person-to-person marketing. Securities dealers can learn customer preferences and provide customers with necessary information from transaction records to maintain good customer relations. Pyals and Payne (2001) applied information technology in CRM to better enhance the utility value. Hishamuddin (2007) pointed out that, with the rapid development of information technology after 2000, the concept of CRM emerged. Ortega (2008), Lassar et al. (2008), Renart (2008), Coltman (2007), and Zineldin (2006) had different definitions of CRM. According to Payne and Frow (2005), the definitions of CRM can be divided into three types: 1) CRM as a special technology of a solution scheme; 2) CRM as a kind of solution technology of integrated service, with the customer as the orientation; 3) CRM as an integrated method to manage customer relations, and therefore, creates value for shareholders. Information technology is only a part of CRM.

RESEARCH METHOD

In this study, by applying the method of ANP, three experts were invited to review the content of the questionnaire content in order to remove any inappropriate dimensions. There are a total of 2 dimensions, 6 guidelines, and 7 factors. The modified questionnaires were then sent to eight experts to determine the relevance between dimensions, guidelines, and factors.

Table 3-1 Expert questionnaire dimensions

Dimension	Operational definition
Service contents	Means account management, ordering system, system settings, and other functions, to provide investors with the function of mobile (ordering) securities service.
Guidelines	Operational definition
Account management	Means the provision of queries of information relating to entrusted turnover, inventory, bills, and equities
Ordering system	Means the installation of the ordering software in the general 3G handsets (java) for ordering.
System settings	Means personalized features, such as setting the font size, timeout ordering dial-up, and connection setting charges according to user preference
Dimension	Operational definition
Switching costs	The perceived additional costs spent when the customer (investor) suspends the existing trading relationships and selects a new securities dealer.
Guidelines	Operational definition
Procedural costs	Refers to economic costs of risk, assessment of cost, learning costs; this type of switching costs are mainly related to spent time and effort.
Factor	Operational definition
Learning costs	Refers to the time and energy costs of the investor learning new relevant capacity or technology to make more effective use of new products.
Economic risk costs	Refers to the uncertainty costs caused by possible negative results when the investor selects a new securities dealers in the case of insufficient information; the involved risks include: performance risk, financial risk, and facilitate risk.
Evaluation and search costs	Time and effort in the search and analysis of the investor to make replacement decisions

Guidelines	Operational definition
Financial costs	Consists mainly of benefit loss costs and financial loss costs. This type of switching costs and the actual measurable financial losses are related.
Factor	Operational definition
Initialization costs	The cost of time and psychological cost of the investor in the initial period of establishing a relationship with the new securities dealer or using a new product.
Benefit loss costs	The cost resulted by the economic benefits generated by continuous contracts or relationships with the existing securities dealer lost when switching, for example: transaction fees discounts.
Monetary loss costs	In addition to the cost of purchasing the new product, it includes all the financial expenditures generated by switching the securities dealer, or the costs generated at the initial period of switching the securities dealer.
Guidelines	Operational definition
Relation type costs	Consists mainly of the personal relational loss costs and brand relationship loss cost. This type of switching costs is caused by the psychological and emotional discomfort caused by damage to the relationship through the loss of recognition.
Factor	Operational definition
Personal relational loss costs	The emotional loss caused by damage to the recognition and connection with the business staffs of the original securities dealer after the switching to the new securities dealer.

Source: compiled by this study

This study found that CRM of securities dealers is very difficult. It is suggested that parts of the costs to maintain CRM be transferred to other departments, or the training costs of CRM talents be saved to feed back to investors in order to create a win-win situation. In the future, the inter-industry alliance of insurance or banking industries can be promoted to enrich the information of "account management" to provide investors with more diversified information. At present, most of the information provided by the securities dealers is the same. In the future, according to the needs of the investors, customized information can be established to provide differentiated services. At present, most mobile ordering systems can be used with the help of a mobile phone. In most cases, for customers using mobile ordering, preferential fees of the mobile phone may reduce their switching rate and help improve the revenues of the securities dealers. For the securities dealers, the rise of mobile ordering can reduce the human resources costs of the securities dealers. Through an e-ordering system, the securities dealers can reduce the number of employees and operating costs to enhance profits.

REFERENCE

1. Burnham, T. A. (2003). Consumer Switching Costs: Atypology, Antecedents, and Consequences. Journal of the Academy of Marketing Science , 31, pp. 109-136.
2. Cheng, P. Y. (2007). Information technology and switching costs. Handbook of economics and information systems , pp. 437-465.
3. Coltman, T. (2007). Why build a customer relationship management capability? Journal of Strategic Information Systems , 16, pp. 301-320.
4. Constantinides, E. (2002). The 4S Web-Marketing Mix model. Electronic Commerce Rresearch and Applocations , 1 (1), pp. 57-76.
5. Grzybowski, L. (2008). Estimating switching costs in mobile telephony in the UK. Journal of Industry,CompetitionandTrade, , 8 (2), pp. 113-132.
6. Hishamuddin Bin Lsmail, D. T. (2007). Technology dimension of CRM: the orientation level and its impact on the business performance of SMEs in Malaysia. International Journal of Electronic Customer Relationship Management , 1 (1), pp. 16-29.
7. Hsin Hsin Chang, S. W. (2009). consumer perception of interface quality, security, and loyalty in electronic commerce. Information & Management , pp. 411-417.
8. Huang, S.-Y., Wu, T.-H., & Chi, Y.-J. (2009, 6). A Study of Environmental Accounting Information Disclosure on Corporate Website. Journal of Accounting and Corporate Governance , 6 (1), pp. 1-30.
9. Kim, M. (2004). The effects of customer satisfaction and switching barrier on customer loyalty in Korean mobile telecommunication services. TelecommunicationsPolicy , 28, pp. 145–159.
10. Klemperer, P. D. (1995). Competition When Comsumer Have Switching Cost: An Overview with Applications to Industrial Organization, Macroeconomics and International Trade. Review of Economic Studies , 62 (4), pp. 515-540.
11. Klemperer, P. (1987). Markets with consumer switching costs. The Quarterly Journal of Economics , pp. 375–394.
12. Lassar, W. M. (2008). Development a CRM strategy in your firm. Journal of Accountancy , 206, pp. 68-73.
13. Maicas, J. (2008). A study of the magnitude and drivers of switching costs in the mobile communications industry. Cuadernos deEconomı´a y Direccio´n delaEmpresa, 35, pp. 27-56.
14. Maicas, J. (2009). The role of (personal) network effects and switching costs in determining mobile users'choice. Journal of Information Technology , 24, pp. 160-171.
15. Matthews, C., & Murray, D. (2007). Helping bank customers switch: A case study. Journal of Financial Services Marketing , 11, pp. 360-369.
16. Ortega, B. H. (2008). Therole of information technology knowledge in B2B development. Journal of E-Business Research , 4 (1), pp. 40-54.
17. Payne, A. &. (2005). A Strategic Framework for Customer Relationship Management. Journal of Marketing , 69, pp. 167-176.
18. Payne, A. &. (2001). Customer Relationship Management in Financial services: Towards information-enable relationship marketing. Journal of Strategic Marketing , 9 (1), pp. 3-27.
19. Porter, M. E. (1980). Comparative Strategy. New York: Free Press.
20. Renart, L. G. (2008). Paths to Continuous Improvement of a CRM strategy. UDK Pregledni Rad Review , 66 (1), pp. 61-77.

21. Shih, K. (2010). Mobile Trading experiences and the endogenous trading signal system. African Journal of Business Management , 21 (10), pp. 282-298.
22. Wen Hsien Tsai, H. W. (2009). Evaluation of mobile services for the future of 3G operators. International Journal of Mobile Communications , 7 (4), pp. 470-493.
23. Zineldin, M. (2006). The royalty of loyalty: CRM, quality and retention. Journal of Consumer
24. Marketing , 23 (7), pp. 430-437.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

FORECASTING WITH FOURIER RESIDUAL MODIFIED ARIMA MODEL- THE CASE OF AIR CARGO IN TAIWAN

Thanh-Lam Nguyen, Graduate Institute of Mechanical and Precision Engineering
National Kaohsiung University of Applied Sciences, Kaohsiung 80778, Taiwan

Peng-Jen Chen, Department of Industrial Engineering and Management
National Kaohsiung University of Applied Sciences, Kaohsiung 80778, Taiwan

Ming-Hung Shu, Department of Industrial Engineering and Management
National Kaohsiung University of Applied Sciences, Kaohsiung 80778, Taiwan

Bi-Min Hsu, Department of Industrial Engineering and Management
Cheng Shiu University, Kaohsiung 83347, Taiwan

Yi-Chang Lai, Department of Industrial Engineering and Management
National Kaohsiung University of Applied Sciences, Kaohsiung 80778, Taiwan

ABSTRACT

Purpose- *Import-export activities normally require the involvement of different sectors needing proper plans to make the trade-flow stably grown. This paper is aimed at establishing an accurate forecasting model for trade volume.*
Design/methodology/approach- *In this study, a new forecasting model named ARIMAF/ SARIMAF was proposed by combining the Fourier series with the conventional ARIMA/ SARIMA forecasting model.*
Findings- *In the cases of historical data of the volumes of imported and exported air cargo in Taiwan, SARIMAF(3,1,1)(1,1,1)$_{12}$ and SARIMAF(2,1,3)(1,1,1)$_{12}$ models were found fitting well with the mean absolute percentage error values of 0.0104 and 0.0096, respectively. Using these two models, the monthly volumes of air cargo in Taiwan in 2012 are predicted.*
Originality/value- *The using Fourier series to modify the residuals of the traditional ARIMA is first proposed in this paper.*

Keywords: Fourier residual modification, ARIMA, forecasting air cargo volume

INTRODUCTION

International trade is defined as the exchange of goods, capital and services across national borders or territories, which usually takes the most important share in the gross domestic products in many countries around the world. It has become one of the most critical factors to develop the national economies and the nations themselves, because most of their resources need rearranged and reallocated for better performance through export activities; also, the countries could have what they need for their people as well as for building their internal powers through import activities. Without international trade, the goods and services available in a nation are limited to what can be produced within its border; some certain goods/services become superfluous if the nation has comparative advantages, whereas, some turn into scarce for consumption and development.

Import and export, two basic activities in international trade, normally require the involvement of many different sectors from purchasing, manufacturing, inventory, transportation, distribution, etc., especially the engagement of the customs authorities in both countries. Therefore, it is of great significance to have appropriate planning from macro to micro levels so that the trade flow can develop affluently among nations. In order to have proper plans, an accurate forecast of the volume of imported-exported goods becomes compulsory.

In predicting the volume of containers used in international trade, many researchers used conventional regression methods only which disregard non-stationary relationship among the volume of containers and the macro-economic variables possibly resulting in the spurious regression forecasting models (Chou et al, 2008).

Autoregressive Integrated Moving Average (ARIMA) model is one of well-known models dealing with time series. And in order to enhance the accuracy level of this model, in this study, a new approach to minimize its residuals is suggested by modifying them with Fourier series. This modification results in a new model, hereinafter called ARIMAF. An empirical study of air cargo in Taiwan is conducted to compare the accuracy of the two mentioned models so as to find out an appropriate one for forecasting the volume of imported and exported air cargo in Taiwan.

LITERATURE REVIEW

1. ARIMA Model

ARIMA model was first introduced by Box and Jenkins in 1960s to forecast a time series which can be made stationary by differencing or logging. A time series may have non-seasonal or seasonal characteristics. Seasonality in a time series is defined as a regular pattern of changes that repeats over S time-periods. With a seasonal time series, there is usually a difference between the average values at some particular times within the seasonal intervals and the average values at other times; therefore, in most cases, a seasonal time series is non-stationary. With a seasonal time series, it can be made stationary by seasonal differencing which is defined as a difference between a value and a value with lag that is a multiple of S.
A non-seasonal ARIMA model has the form of ARIMA(p,d,q) while the seasonal ARIMA model comes in the form of SARIMA(p,d,q)$(P,D,Q)_S$, where:

- p is Auto-Regressive term.
- d is Integrated term.
- q is Moving-Average term.
- P is the number of seasonal Autoregressive order.
- D is the number of seasonal differencing.
- Q is the number of seasonal Moving Average order.
- S is the time span of repeating seasonal pattern.

“Auto-Regressive” term refers to the lags of the differenced series appeared in the forecasting equation and “Moving Average” term refers to the lags of the forecast errors. A time series differenced to be made stationary is said to be "integrated". “Integrated” term refers to the difference levels to make a time series stationary.

The overall procedures of ARIMA (SARIMA) methodology are: (1) identifying the possible models; (2) fitting the models; and (3) testing for their adequacy & reliability before being applied to forecast (Hanke & Wichern, 2005).

** Step 1: Identifying the possible models*

- By using the Auto-Correlation Function (ACF) graph, the stationarity of the time series can be easily determined. If the lag values of the graph cut off fairly quickly or die down fairly quickly, the time series is considered stationary; otherwise, it isn't. If the series is not stationary, it should be differenced gradually until it is considered stationary. Then, the d value in the ARIMA(p,d,q) is obtained. The values of p and q are determined based on ACF and Partial Auto-Correlation Function (PACF) graph as in table 1.

Table 1: Determine the p & q parameters by using ACF and PACF graph

Model	ACF	PACF
AR(p)	Dies down fairly quickly	Cut off after lags p fairly quickly
MA(q)	Cut off after lags q fairly quickly	Dies down fairly quickly
ARMA(p,q)	Dies down fairly quickly	Dies down fairly quickly

- Examine the patterns across lags that are multiples of *S* to identify seasonal terms. Judge the ACF and PACF at the seasonal lags in the same way.

** Step 2: Fitting the model*

Once a tentative model is selected, its parameters are then estimated. Therefore, this stage is also called "Estimating the model".

** Step 3: Testing the model for adequacy*

The model adequacy is tested by considering the properties of the residuals. The residuals must have normal distribution and be white-noise (also known random). This test can be done with one of the following ways:

- Ljung-Box Q statistic:

$$Q_m = n(n+2)\sum_{k=1}^{m}\frac{e_k^2}{n-k} \qquad (1)$$

where: e_k is the residual autocorrelation at lag k
n is the number of residuals
m is the number of time lags includes in the test

If the p-value associated with the Ljung-Box Q Statistic is smaller than a given significance, the model is considered inadequate. Otherwise, it is appropriate for further application.

- Testing the normal distribution of the residuals by considering the normal probability plot and testing the white-noise of the residuals by considering its ACF and PACF graphs

where individual residual autocorrelation should be small and its value is within $\pm 2/\sqrt{n}$ from the central point of zero.

2. Fourier Residual Modification ARIMA Model (ARIMAF)

In order to improve the accuracy of forecasting models, the Fourier series has been successfully applied in modifying the residuals in Grey forecasting model GM(1,1) (Askari & Fetanat, 2011; Guo et al, 2005; Hsu, 2003; Huang & Lee, 2011; Kan et al, 2010) which reduces the values of RMSE, MAE, MAPE, etc., Thus, this good methodology should be considered in the case of ARIMA (SARIMA) model.

The procedure to obtain the modified residuals from ARIMA (SARIMA) model with Fourier series is as the following.

Suppose an original series with n entries is $x=\{x(1),x(2),x(3),\ldots,x(k),\ldots,x(n)\}$ and its predicted series under ARIMA (SARIMA) is $\hat{x}=\{\hat{x}(1),\hat{x}(2),\hat{x}(3),\ldots,\hat{x}(k),\ldots,\hat{x}(n)\}$; then, its residual series ε is defined as:

$$\varepsilon=\{\varepsilon(1),\varepsilon(2),\varepsilon(3),\ldots,\varepsilon(k),\ldots,\varepsilon(n)\} \qquad (k=\overline{1,n}) \qquad (1)$$

where $\varepsilon(k)=x(k)-\hat{x}(k) \qquad (k=\overline{1,n})$

Now, let's consider a sub-series ε^* as:

$$\varepsilon^*=\{\varepsilon(2),\varepsilon(3),\ldots,\varepsilon(k),\ldots,\varepsilon(n)\} \qquad (k=\overline{2,n}) \qquad (2)$$

Expressed in Fourier series, $\varepsilon(k)$ is rewritten as:

$$\varepsilon(k)=\frac{1}{2}a_0+\sum_{i=1}^{D}\left[a_i\cos\left(\frac{2\pi i}{n-1}k\right)+b_i\sin\left(\frac{2\pi i}{n-1}k\right)\right] \qquad (k=\overline{2,n}) \qquad (3)$$

where $D=\left[(n-1)/2-1\right]$ is called the minimum deployment frequency of Fourier series (Huang & Lee, 2011) and only take integer number (Askari & Fetanat, 2011; Guo et al, 2005; Hsu, 2003).

And therefore, the residual sub-series ε^* is rewritten as:

$$\varepsilon^*=P.C \qquad (4)$$

where

$$P=\begin{bmatrix} \frac{1}{2} & \cos\left(\frac{2\pi\times1}{n-1}\times2\right) & \sin\left(\frac{2\pi\times1}{n-1}\times2\right) & \cdots & \cos\left(\frac{2\pi\times D}{n-1}\times2\right) & \sin\left(\frac{2\pi\times D}{n-1}\times2\right) \\ \frac{1}{2} & \cos\left(\frac{2\pi\times1}{n-1}\times3\right) & \sin\left(\frac{2\pi\times1}{n-1}\times3\right) & \cdots & \cos\left(\frac{2\pi\times D}{n-1}\times3\right) & \sin\left(\frac{2\pi\times D}{n-1}\times3\right) \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ \frac{1}{2} & \cos\left(\frac{2\pi\times1}{n-1}\times n\right) & \sin\left(\frac{2\pi\times1}{n-1}\times n\right) & \cdots & \cos\left(\frac{2\pi\times D}{n-1}\times n\right) & \sin\left(\frac{2\pi\times D}{n-1}\times n\right) \end{bmatrix}$$

$$C=[a_0,a_1,b_1,a_2,b_2,\ldots,a_D,b_D]^T$$

By using the ordinary least squares method (OLS), the values of $a_0,a_1,b_1,a_2,b_2,\ldots,a_D,b_D$ are

obtained from the equation of:

$$C = \left(P^T P\right)^{-1} P^T \left[\varepsilon^*\right]^T \tag{5}$$

Then, the predicted residual $\hat{\varepsilon}(k)$ is now easily achieved based on the equation (3) as:

$$\hat{\varepsilon}(k) = \frac{1}{2}a_0 + \sum_{i=1}^{D}\left[a_i \cos\left(\frac{2\pi i}{n-1}k\right) + b_i \sin\left(\frac{2\pi i}{n-1}k\right)\right] \tag{6}$$

So, based on the predicted series $\hat{x}$ obtained previously, the predicted series $\breve{x}$ from the Fourier residual modification of ARIMA model (SARIMA) is determined by:

$$\breve{x} = \left\{\breve{x}(1), \breve{x}(2), \breve{x}(3), \ldots, \breve{x}(k), \ldots, \breve{x}(n)\right\} \tag{7}$$

where
$$\begin{cases} \breve{x}(1) = \hat{x}(1) \\ \breve{x}(k) = \hat{x}(k) + \hat{\varepsilon}(k) \qquad \left(k = \overline{2,n}\right) \end{cases}$$

In evaluating the model accuracy and comparing models, there are important indexes to be considered, such as:

- The mean absolute percentage error (MAPE) (Askari & Fetanat, 2011; Chang & Liao, 2010; Guo et al, 2005; Hsu & Chen, 2003; Hsu & Wang, 2008; Huang & Lee, 2011; Kan et al, 2010; Li et al, 2011; Tsaur & Kuo, 2011):

$$MAPE = \frac{1}{n}\sum_{k=1}^{n}\frac{|x(k) - v(k)|}{x(k)} \qquad \left(k = \overline{1,n}\right)$$

where $v(k)$ is the predicted value of entry k $\left(k = \overline{1,n}\right)$ (so, $v(k) = \hat{x}(k)$ in ARIMA model or $v(k) = \breve{x}(k)$ in SARIMA model).

+ The post-error ratio *C* (Hua & Liang, 2009; Ma & Zhang, 2009): $C = \frac{S_2}{S_1}$

where: + $S_1 = \sqrt{\frac{1}{n}\sum_{k=1}^{n}\left[x(k) - \bar{x}\right]^2}$ *where* $\bar{x} = \frac{1}{n}\sum_{k=1}^{n}x(k)$

+ $S_2 = \sqrt{\frac{1}{n}\sum_{k=1}^{n}\left[\varepsilon(k) - \bar{\varepsilon}\right]^2}$ *where* $\varepsilon(k) = x(k) - v(k)$ *and* $\bar{\varepsilon} = \frac{1}{n}\sum_{k=1}^{n}\varepsilon(k)$

The smaller the *C* value is, the higher accuracy the model has since smaller *C* value results from a larger S_1 and/or a smaller S_2.

- The small error probability *P* (Hua & Liang, 2009; Ma & Zhang, 2009):

$$P = p\left\{\frac{\left|\varepsilon(k) - \bar{\varepsilon}\right|}{S_1} < 0.6745\right\}$$

The higher the *P* value is, the higher accuracy the model has since *P* value indicates the probability of the ratio of the difference between the residual values of data points and the average residual value with the standard deviation of the original series smaller than 0.6745 (Ma & Zhang, 2009).

- The forecasting accuracy ρ (Ma & Zhang, 2009): $\rho = 1 - MAPE$

Based on the above indexes, there are four grades of forecasting accuracy as stated in table 1.

Table 1: Four grades of forecasting accuracy

Grade level	*MAPE*	*C*	*P*	ρ
I (Very good)	< 0.01	< 0.35	> 0.95	> 0.95
II (Good)	< 0.05	< 0.50	> 0.80	> 0.90
III (Qualified)	< 0.10	< 0.65	> 0.70	> 0.85
IV (Unqualified)	≥ 0.10	≥ 0.65	≤ 0.70	≤ 0.85

METHODS

The historical data of the volume of imported-exported air cargo in Taiwan are obtained from the monthly statistical data published on the website of Ministry of Transportation and Communication R.O.C (MOTC) from January 2002 to December 2011. There are totally 120 observations of monthly volume of imported air cargo and exported air cargo of Taiwan.

The data are used to establish relevant ARIMA (SARIMA) and ARIMAF (SARIMAF) models which are then tested for their accuracy before they are used to predict the volume of imported-exported air cargo in Taiwan in year 2012. The volumes of imported and exported air cargo are respectively named as IMP and EXP variables.

To deal with ARIMA (SARIMA) model, computer software called Statistical Package for the Social Sciences (SPSS) is used whereas Microsoft Excel is used to deal with the Fourier residual modification.

Firstly, using SPSS program, time series plots are examined for the seasonality feature before coming up with ARIMA (SARIMA) models. After an appropriate model is selected, it is then used to calculate the predicted values of the observations to figure out its accuracy level and its residual series as well.

Secondly, in order to increase the accuracy level of the ARIMA (SARIMA) model, the residual series is modified with Fourier series as expressed in section 2.2. At the end of this stage, a modified residual series is obtained for the next step.

Thirdly, with the modified series, a predicted series under ARIMAF (SARIMAF) model is calculated as stated in equation (7). This predicted series will be used to determine the actual residuals from ARIMAF (SARIMAF) model for evaluating its accuracy.

Finally, a comparison between the conventional ARIMA (SARIMA) model and ARIMAF (SARIMAF) model is conducted to prove that ARIMAF (SARIMAF) model is better than ARIMA (SARIMA) model.

EMPIRICAL STUDY

1. The Volume of Imported Air Cargo in Taiwan

1.1 ARIMA model

The data of the volume of imported air cargo are tested and show that the original data set of IMP is not stationary but seasonal. However, at one degree of both non-seasonal and seasonal difference, the series becomes stationary. Figure 1 shows that there are two possible SARIMA models for IMP: $SARIMA(1,1,1)(1,1,1)_{12}$ and $SARIMA(3,1,1)(1,1,1)_{12}$.

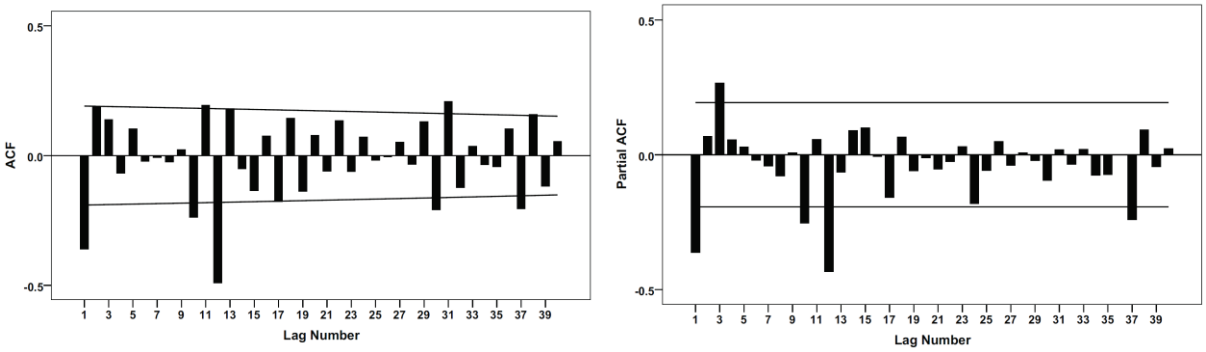


Figure 1: ACF and PACF of IMP at one degree of both non-seasonal and seasonal difference

The summary statistics for the two SARIMA models are shown in Table 2.

Table 2: Summary statistics of 2 SARIMA Models for IMP

	Model Fit statistics				Ljung-Box Q(18)		
Model	R-squared	RMSE	MAPE	MAE	Statistics	DF	Sig.
$SARIMA(1,1,1)(1,1,1)_{12}$	0.728	2876.656	0.0585	2273.735	13.263	14	0.506
$SARIMA(3,1,1)(1,1,1)_{12}$	0.736	2861.977	0.0567	2208.193	8.428	12	0.751

Based on the significance of Ljung-Box Q statistic in Table 2, the two models are all adequate to do the forecasting of IMP. However, $SARIMA(3,1,1)(1,1,1)_{12}$ is finally selected because it has lower MAPE. Figure 2 & Figure 3 illustrate that the residual of $SARIMA(3,1,1)(1,1,1)_{12}$ is really white noise.

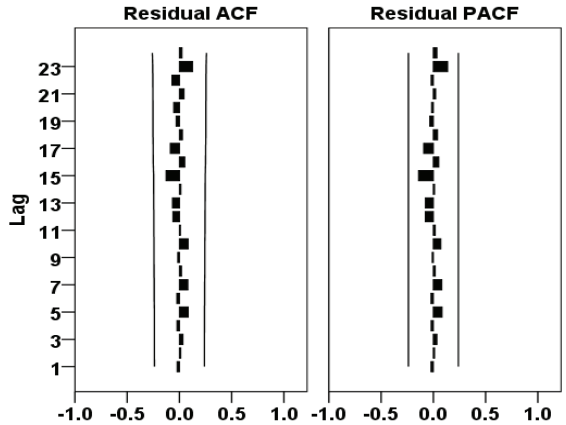


Figure 2: Noise residual ACF and PACF from SARIMA(3,1,1)(1,1,1)$_{12}$ of IMP

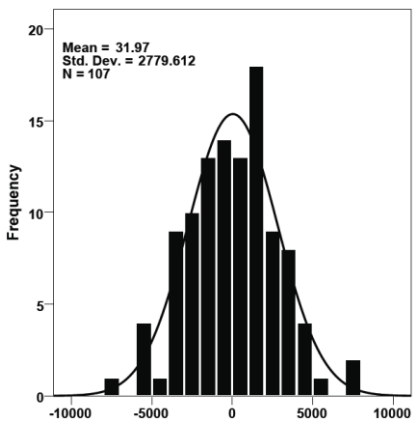


Figure 3: Noise residual from SARIMA(3,1,1)(1,1,1)$_{12}$ of IMP

1.2 Fourier residual modification ARIMA model (ARIMAF)

From the residual series of $SARIMA(3,1,1)(1,1,1)_{12}$, a Fourier modified residual series is calculated as per the procedure mentioned in section 2.2. With this modified series, the forecasted values of IMP based on Fourier residual modified $SARIMA(3,1,1)(1,1,1)_{12}$ model ($SARIMAF(3,1,1)(1,1,1)_{12}$) are obtained based on the equation (7).

Table 3 briefly demonstrates the evaluation indexes of each model with its power in forecasting the volume of imported air cargo in Taiwan.

Table 3: Summary of evaluation indexes of model accuracy

Index / Model	MAPE	S1	S2	C	P	ρ	Forecasting power
$SARIMA(3,1,1)(1,1,1)_{12}$	0.0567	5387.86	2766.59	0.5135	0.8148	0.9433	***Qualified***
$SARIMAF(3,1,1)(1,1,1)_{12}$	0.0104	5387.86	466.76	0.0866	0.9907	0.9896	***Very good***

Based on the indexes in Table 3, it is concluded that Fourier residual modification has improved the forecasting accuracy level of the conventional SARIMA model. Therefore, it is suggested to use $SARIMAF(3,1,1)(1,1,1)_{12}$ model for forecasting the volume of imported air cargo in Taiwan. For the monthly volume in year 2012, the forecasted values based on this model are as in column forecasted imports (FIMP) of Table 6.

2. The Volume of Exported Air Cargo in Taiwan

2.1 ARIMA model

The data of the volume of exported air cargo are tested and show that they are not stationary but seasonal. However, at one degree of both non-seasonal and seasonal difference, the series becomes stationary. Figure 4 shows that there are six possible SARIMA models for EXP:

$SARIMA(1,1,1)(1,1,1)_{12}$ $SARIMA(2,1,1)(1,1,1)_{12}$ $SARIMA(3,1,1)(1,1,1)_{12}$
$SARIMA(1,1,3)(1,1,1)_{12}$ $SARIMA(2,1,3)(1,1,1)_{12}$ $SARIMA(3,1,3)(1,1,1)_{12}$

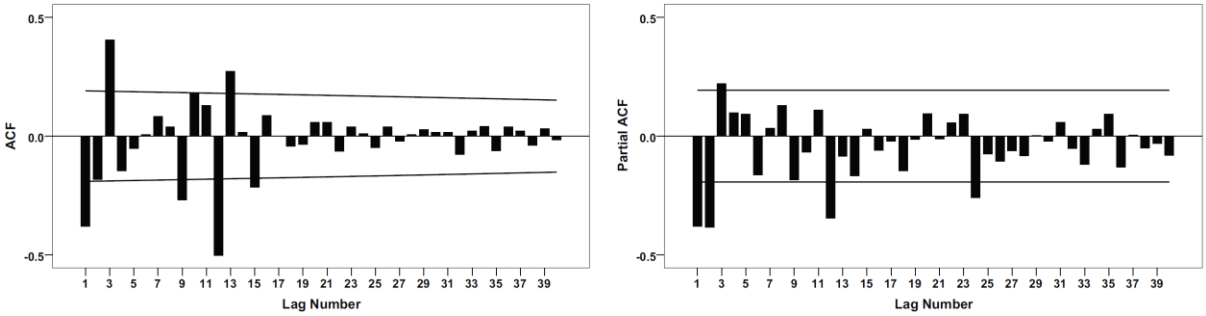


Figure 4: ACF and PACF of EXP at one degree of both non-seasonal and seasonal difference

The summary statistics for the six SARIMA models are shown in Table 4.

Table 4: Summary statistics of 6 SARIMA Models for EXP

Model	Model Fit statistics	Ljung-Box Q(18)

	R-squared	RMSE	MAPE	MAE	Statistics	DF	Sig.
$SARIMA(1,1,1)(1,1,1)_{12}$	0.658	5073.341	0.0662	3488.019	21.031	14	0.101
$SARIMA(2,1,1)(1,1,1)_{12}$	0.690	4850.421	0.0636	3350.076	10.295	13	0.670
$SARIMA(3,1,1)(1,1,1)_{12}$	0.691	4870.054	0.0637	3344.354	10.104	12	0.607
$SARIMA(1,1,3)(1,1,1)_{12}$	0.687	4899.883	0.0635	3340.522	11.123	12	0.518
$SARIMA(2,1,3)(1,1,1)_{12}$	0.692	4885.260	0.0633	3326.270	9.567	11	0.570
$SARIMA(3,1,3)(1,1,1)_{12}$	0.693	4901.227	0.0633	3326.662	9.250	10	0.509

Based on the significance of Ljung-Box Q statistic in Table 4, the six models are all adequate to do the forecasting of EXP. However, $SARIMA(2,1,3)(1,1,1)_{12}$ and $SARIMA(3,1,3)(1,1,1)_{12}$ have the lowest values of MAPE & MAE and Figure 5 to Figure 8 show that their residuals are really white noise; thus, they are finally selected. The residual series from these 2 models are modified with Fourier series in the next stage. After that, one of them will be finally selected based on their MAPE & MAE values.

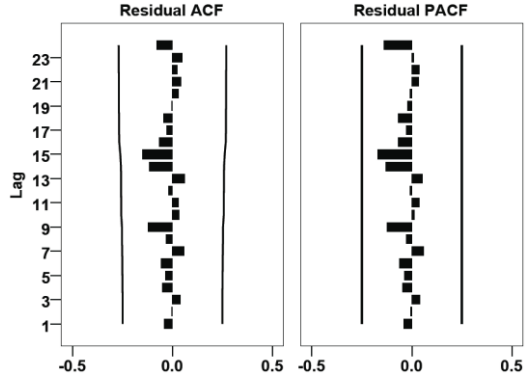


Figure 5: Noise residual ACF and PACF from $SARIMA(2,1,3)(1,1,1)_{12}$ of EXP

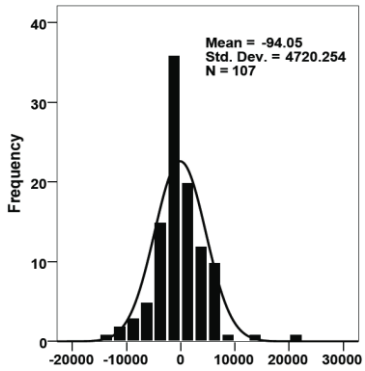


Figure 6: Noise residual from $SARIMA(2,1,3)(1,1,1)_{12}$ of EXP

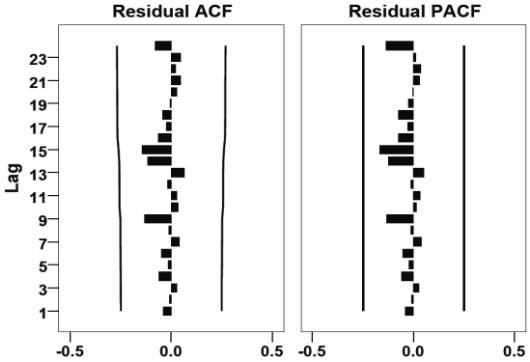


Figure 7: Noise residual ACF and PACF from $SARIMA(3,1,3)(1,1,1)_{12}$ of EXP

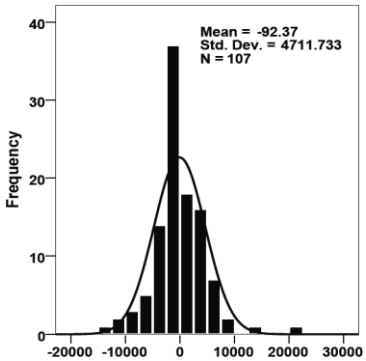


Figure 8: Noise residual from $SARIMA(3,1,3)(1,1,1)_{12}$ of EXP

2.2 Fourier residual modification ARIMA (SARIMA) model (ARIMAF- SARIMAF)

The two residual series of $SARIMA(2,1,3)(1,1,1)_{12}$ and $SARIMA(3,1,3)(1,1,1)_{12}$, are now modified based on the algorithm of Fourier series in section 2.2. These two modified series are then applied to equation (7) to adjust the forecasted values of EXP based on $SARIMAF(2,1,3)(1,1,1)_{12}$ and $SARIMAF(3,1,3)(1,1,1)_{12}$ models, respectively.

Table 5 briefly demonstrates the evaluation indexes of each model with its power in

forecasting the volume of exported air cargo in Taiwan.

Table 5: Summary of evaluation indexes of model accuracy

Index / Model	MAPE	S1	S2	C	P	ρ	Forecasting power
$SARIMA(2,1,3)(1,1,1)_{12}$	0.0633	8464.63	4698.12	0.5550	0.8505	0.9367	***Qualified***
$SARIMAF(2,1,3)(1,1,1)_{12}$	0.0096	8464.63	568.35	0.0671	1.0000	0.9904	***Very good***
$SARIMA(3,1,3)(1,1,1)_{12}$	0.0633	8464.63	4689.67	0.5540	0.8411	0.9367	***Qualified***
$SARIMAF(3,1,3)(1,1,1)_{12}$	0.0096	8464.63	597.56	0.0706	1.0000	0.9904	***Very good***

Table 5 shows that $SARIMAF(2,1,3)(1,1,1)_{12}$ with the post-error ratio C value of 0.0671 outperforms $SARIMAF(3,1,3)(1,1,1)_{12}$ and other two SARIMA models in forecasting the volume of exported air cargo in Taiwan. As a result, $SARIMAF(2,1,3)(1,1,1)_{12}$ is selected. The forecasted values of the volume of exported air cargo in year 2012 based on this model are demonstrated in column forecasted exports (FEXP) in Table 6.

Furthermore, the indexes in Table 5 clearly show that the conventional SARIMA models gain much higher accuracy once their residuals are modified with Fourier series. Along with the case of the volume of imported air cargo discussed in section 4.1.2, it is now affirmably concluded that Fourier residual modification considerably enhances the accuracy level of SARIMA model. Thus, the volume of imported-exported air cargo in Taiwan should be forecasted with SARIMAF models instead of the traditional SARIMA models.

Under SARIMAF models, the forecasted values of the monthly volume of imported and exported air cargo in Taiwan in year 2012 are respectively summarized in column FIMP and FEXP. Consequently, the total monthly traffic of air cargo is illustrated in column FTAC of Table 6.

Table 6: Forecasted volume of air cargo in Taiwan with SARIMAF model (Unit: MT)

Volume / *Month*	*Forecasted imports (FIMP)*	*Forecasted exports (FEXP)*	*Forecasted traffic of Air-cargo (FTAC)*
January	37,573	37,268	74,841
February	27,835	27,715	55,550
March	37,435	48,135	85,570
April	42,485	45,834	88,319
May	38,321	43,861	82,182
June	39,073	47,472	86,545
July	46,409	50,504	96,913
August	42,991	48,013	91,004
September	37,762	42,935	80,697
October	40,955	69,157	110,112
November	40,902	34,222	75,124
December	35,708	32,230	67,938

CONCLUSION

ARIMAF/SARIMAF models, which are created by combining the traditional ARIMA/ SARIMA model with the Fourier residual modification, has been proved to be a good model in forecasting the volume of imported-exported air cargo in Taiwan. In this empirical case, it is strongly suggested to use $SARIMAF(3,1,1)(1,1,1)_{12}$ for the import volume and $SARIMAF(2,1,3)(1,1,1)_{12}$ for the export volume due to their low values of MAPE 0.0104 and 0.0096, respectively, which prove that the forecasted values follow closely to the actual figures. These accurate forecasting models will help the authorities and related industries in Taiwan make appropriate plans for the stable development of Taiwan international trade by air.

Fourier residual modification has been successfully applied to the fundamental form of Grey forecasting model GM(1,1) and the ARIMA/ SARIMA models; therefore, it is thought to work well with other forecasting models as well. Further researches on this application should be conducted before the suggestion is firmly verified.

REFERENCES

1. Askari, M., and Fetanat, A. (2011), "Long-term load forecasting in power system: Grey system prediction-based models", Journal of Applied Sciences, Vol. 11, pp. 3034-3038.
2. Chang, Y.W., and Liao, M.Y. (2010), "A seasonal ARIMA model of tourism forecasting: The case of Taiwan", Asia Pacific Journal of Tourism Research, Vol. 15, pp. 215-221.
3. Chou, C.C., Chu, C.W., and Liang, G.S. (2008), "A modified regression model for forecasting the volumes of Taiwan's import containers", Mathematical and Computer Modelling, Vol. 47, pp. 797-807.
4. Guo, Z., Song, X., and Ye, J. (2005), "A Verhulst model on time series error corrected for port throughput forecasting", Journal of the Eastern Asia Society for Transport Studies, Vol. 6, pp. 881-891.
5. Hanke, J.E., and Wichern, D.W. (2005), Business Forecasting, Pearson, Prentice Hall, New Jersey.
6. Hsu, C.C., and Chen, C.Y. (2003), "Applications of improved grey prediction model for power demand forecasting", Energy Conversion and Management, Vol. 44, pp. 2241-2249.
7. Hsu, L.C. (2003), "Applying the grey prediction model to the global integrated circuit industry", Technological forecasting & Social change, Vol. 70, pp. 563-574.
8. Hsu, L.C., and Wang, C.H. (2008), "The development and testing of a modified Diffusion model for predicting tourism demand", International Journal of Management, Vol. 25, pp. 439-445.
9. Hua, J., and Liang, Q. (2009), "Application research of the Grey forecast in the Logistics demand forecast", First International Workshop on Education Technology and Computer Science, Vol. 3, pp. 361-363.
10. Huang, Y.L., and Lee, Y.H. (2011), "Accurately forecasting model for the Stochastic Volatility data in tourism demand", Modern Economy, Vol. 2, pp. 823-829.
11. Kan, M.L., Lee, Y.B., and Chen, W.C. (2010), "Apply grey prediction in the number of Tourist", in The fourth international conference on Genetic and Evolutionary computing in Shenzhen, China, 2010, pp. 481-484.

12. Li, G.D., Wang, C.H., Masuda, S., and Nagai, M. (2011), "A research on short term load forecasting problem applying improved grey dynamic model", Electrical power and Energy systems, Vol. 33, pp. 809-816.
13. Ma, H., and Zhang, Z. (2009), "Grey prediction with Markov-Chain for Crude oil production and consumption in China", Advances in Intelligent and Soft Computing, Vol. 56, pp. 551-561.
14. Ministry of Transportation and Communication R.O.C, Monthly Statistics, Retrieved on Feb. 25, 2012 from http://www.motc.gov.tw/motchypage/monthly_eng/c6040.xls
15. Tsaur, R.C., and Kuo, T.C. (2011), "The adaptive fuzzy time series model with an application to Taiwan's tourism demand", Expert systems with Applications, Vol. 38, pp. 9164-9171.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE CIVILIZATIONAL DETERMINANTS OF POLAND'S DEVELOPMENT

Elżbieta Mączyńska, Warsaw School of Economics, email: ela4@wp.pl

ABSTRACT

Prospects for the further civilizational development and success of Polandhave their source in the characteristics, quality, and dimensions of Poland's socio-economic potential, which still remains inadequately used. The progress made during the over twenty-year long transformation of the economic system and the implementation and strengthening of the market economy clearly shows Poland's great capacities in terms of the economy and the intellectual base. This is clearly reflected by statistics. The recent global recession, which Poland managed to avoid as the only country in the European Union, has paradoxically emphasized Poland's economic advantages. Unfortunately, this situation is often perceived as an outlier rather than a manifestation of the growing power of Poland's economy, which is evidenced by many comments on the topic published, among others by international research centres. Of late, however, more and more opinions have been appreciative of the deeper foundations of Poland's success. One example is a recent comparative study carried out by IHS Global Insight, which shows that Poland did not give in to the global recession and, being the largest country among the new EU members, represents a relatively strong economic potential. The strength of Poland's economy is not, however, popularly acknowledged, especially since the term "polnische Wirtschaft" was historically used in a pejorative sense, implying Polish mismanagement. However, this term is gradually growing obsolete for many reasons, mostly related to the characteristics, quality, and size of Poland's socio-economic potential. To date, this potential has not been properly used, which also testifies to the substantial scale of the untapped reserves.

Key words: economic order, crisis, punctuated equilibrium, Poland, civilizational development, knowledge-based economy, wisdom-based economy

INTRODUCTION

Under conditions of massive turmoil in the global economy and increasing manifestations of the economics of impermanence, it seems extremely risky, or even irresponsible, to offer any predictions, especially for events decades ahead. One has to take into consideration the rising incidence of Taleb's "black swans," i.e., phenomena which are commonly believed to be impossible to occur (Taleb 2007). The complexity of this issue has been proved, among others, in the debate "What economists think about the future" (Kleer, Mączyńska, and Wierzbicki, eds. 2009, pp. 72–98). Due to the unprecedentedly dynamic technological development as well as and technical, economic, financial, social, and political innovations, the world economy is becoming increasingly unstable and "moveable," while successive waves of innovation lead not only to desirable "creative reconstruction" or creative destruction, but also to the kind of destruction that produces irreversible or difficult-to-reverse, far-reaching social, economic, environmental, and spatial consequences, radically changing the situation of people, enterprises, institutions, and whole countries. These turbulent changes call for profound reflection on creativity and destruction in the economy.

This is all the more important since, in spite of various global initiatives undertaken to mitigate the disproportions and distortions in the economy, so far no country can boast a fully satisfactory and lasting solution to these problems.

The first decade of the 21st century will go down in economic history as a period of unusually sharp disagreements as to the role of economic theory and socio-economic policy in the face of the mounting, hardly solvable problems of global proportions—the Gordian knots of the contemporary world. A particularly serious issue is the state of punctuated equilibrium in various fields of life and the resulting dangers for the sustainable, harmonious development of the world. While economists do not fully agree as to the hierarchization of particular threats in terms of their gravity and as to their exact nature, they tend to concur that the most dangerous are the demographic ones, resulting from the extremely rapid growth of the world's general population coupled with the failing birth rates and the dynamically accelerating process of population aging in the developed countries. This, in turn, has an adverse effect on civilizational progress. Hence, the decisive importance of socio-economic policy, which is a derivative of the adopted framework of the socio-economic system. Systemic issues continue to give rise to disputes, primarily pertaining to the role of the state in the economy, but also to the role of particular economic theories or schools in shaping it. Admittedly, controversies and discussions on this subject have been going on since time immemorial, but recently they have become spectacularly heated ("What Went Wrong …" 2009). The titles of publications devoted to this subject speak for themselves, proving the dysfunctionality of economics in solving major social and economic problems (Krugman 2008, 2009a; Lucas, 2009; Cochrane 2009; Leith 2009; Gomulka, 2009; Skidelsky 2009). Currently, we are witnessing a difficult and very controversial debate about the necessary changes in the role of 21st-century science, business, and politics in solving the major problems of the contemporary world.

It is assumed in this paper that attempts to deal with these issues face barriers arising from the fact that the socio-economic policy has not been well adjusted to the challenges resulting from the ongoing global civilization breakthrough, which is reflected in the industrial civilization being superseded by a new economy and its new, still undefined model. Thus, as the underlying causes of the difficulties in satisfactorily resolving socio-economic problems are unconventional, they also require unconventional strategies. However, the undertaken actions are predominantly typical of the passing industrial model (Toffler and Toffler 1996; Beck 2002; Toffler 2003; Rifkin 2003). "Marx would have a good laugh"—thus Italian philosopher Antonio Negri comments on these phenomena, adding that "The funny thing is that when the world is changing, we stick to models from 100 years ago. Financial capital leads to a new accumulation, and so to new social differences and the new poor, while joint stock companies embody the communism of capital" (interview with A. Negri 2010). But the politicians and managers who are trying to find a remedy pay insufficient attention (whether consciously or not) to contemporary trends in the global economy resulting from the civilization breakthrough. The effectiveness of undertaken actions is determined by their adaptation to the conditions of the breakthrough, the civilization of knowledge, and the related new requirements. This also applies to the model of the economic system. These issues are not adequately reflected or appreciated in the global or local socio-economic policies. This has been confirmed both by research and by expert debates, which have shown that meeting the most pressing challenges of the 21st century will require close cooperation between scientific communities, politicians, businesses, and governments. A leading

participant in this debate, Dennis L. Meadows, who co-authored *The Limits to Growth*, argues that "we could discuss solutions to problems of the future at will, but if we do not act differently than in the past, nothing is going to change." (Science...2009).

Under such conditions, a civilization of knowledge does not become synonymous with a civilization of reason and wisdom. The past experiences of the global economy show a significant dichotomy between knowledge and wisdom. The main challenge is thus to counteract this dichotomy. In the case of Poland, this challenge is twofold. First, it is necessary to catch up with more developed countries in terms of R&D investment and, second, to intensify the rational implementation of the globally available knowledge resources with a focus on socio-economic welfare. To meet this challenge, Poland's unused development potential must be activated, which is also a prerequisite for the elimination of barriers to development. But knowledge alone is not enough; the other key element is strategic wisdom. What is also needed is some futurological reflection free of the ubiquitous short-termism, or the prioritization of short-sighted objectives.

POLAND'S UNUSED POTENTIAL

Prospects for the further civilizational development and success of Poland have their source in the characteristics, quality, and dimensions of Poland's socio-economic potential, which still remains inadequately used. The progress made during the over twenty-year long transformation of the economic system and the implementation and strengthening of the market economy clearly shows Poland's great capacities in terms of the economy and the intellectual base. This is clearly reflected by statistics. The recent global recession, which Poland managed to avoid as the only country in the European Union, has paradoxically emphasized Poland's economic advantages. Unfortunately, this situation is often perceived as an outlier rather than a manifestation of the growing power of Poland's economy, which is evidenced by many comments on the topic published, among others by international research centres. Of late, however, more and more opinions have been appreciative of the deeper foundations of Poland's success. One example is a recent comparative study carried out by IHS Global Insight, which shows that Poland did not give in to the global recession and, being the largest country among the new EU members, represents a relatively strong economic potential. "Poland's economy grew even amid the global recession. The largest economy from the new European Union (EU) members played a key stabilizing role during the global recession and avoided falling into recession itself. The modest increase of unemployment during 2009—while nominal wages were still rising—goes a long way toward explaining the relative strength of Poland's economy. Nonetheless, what pulled the trick was the combination of robust internal demand and the zloty's depreciation between July 2008 and January 2009, which improved Poland's trade balance a great deal" (*PlanEcon Monthly Report* 2010, p. 38).

The strength of Poland's economy is not, however, popularly acknowledged, especially since the term "polnische Wirtschaft" was historically used in a pejorative sense, implying Polish mismanagement. However, this term is gradually growing obsolete for many reasons, mostly related to the characteristics, quality, and size of Poland's socio-economic potential. To date, this potential has not been properly used, which also testifies to the substantial scale of the untapped reserves.

The socio-economic sources of Poland's comparative advantage include:

a) A large market potential and growing domestic demand generated by a population of over 38 million.
b) An increasing gross enrolment ratio (GER), and thus a greater percentage of population with higher education, which encourages productivity and social mobility. (GER for higher education has increased from 12.9% in the academic year 1990-1991 to 52.7% in academic year 2008-2009).
c) A historically conditioned ability to respond flexibly to threats and to changing circumstances (Polish people are famous for their ability to improvise), and thus openness to new trends, which increases the possibility of taking advantage of the opportunities offered by the civilization breakthrough and the emerging new economic model, including virtualized economy (Wikinomics).
d) Intensification of infrastructural investments (e.g., using EU subsidies), which generates investment multipliers and translates into additional growth impetus for gross domestic product—a measure of national wealth.
e) Multiplier effects that may be brought about by the development of the housing sector (this is inevitable due to the underdevelopment of the sector and the concurrent rising housing aspirations of Poles, which implies a potentially large housing demand). In the future, this may constitute an additional strong driving force behind the economy.
f) Poland's economically advantageous central geographical location, which aids the intensified development of various forms of foreign investment, international consortia, IT centres, etc.
g) The climate and natural resources, with the increasingly likely prospects of finding new natural resources and energy.
h) Cultural factors, founded on Poland's historically high cultural position in Europe and in the world, marked by openness to new trends and tendencies in various areas of life, which is always conducive to economic development.
i) The still underused but rising potential of Poland's tourism (not only due to the economic development, but also to climate change) and the untapped growth potential of the tourism industry as an important sector of the economy.
j) The potential of "backwardness rent" and the possibility of "leapfrogging" in various fields, i.e., moving immediately to a higher stage of development passing over the intermediate stages which the developed countries had to go through in the past. This is possible by using other countries' experience to shorten the time of achieving a higher level and by learning from the mistakes of others to reduce the risk of error.

At the same time, unfortunately, Poland is not free from serious threats to harmonious, sustainable socio-economic development, the principal ones being:

a) Demographic threats: population aging and the processes of depopulation (forecasts indicate that by 2050 Poland's population may decline from over 38 million today to 31 million, a drop of 7 million).
b) Rising public debt and difficulties in achieving sustainable public finances (this is closely associated with demographic threats and increased spending on pensions and health care).
c) Dysfunctions in the development and implementation of the research potential, resulting in many valuable discoveries "leaking" from Poland (e.g., the invention of the blue laser, etc.).

d) Inefficiency of legislation and law enforcement, including an inefficient judiciary system and excessively long judicial proceedings.
e) A dysfunctional political system with the electoral cycle syndrome, which is harmful to the economy due to the priority of election objectives over macroeconomic and socioeconomic efficiency. This reinforces the widespread phenomenon in democratic systems that can be aptly summarized with the phrase "efficiency has no electorate." The syndrome of a short electoral cycle and the resulting predominance of a short-term perspective is coupled with neglecting the strategic thinking culture, and is not conducive to investing in the economy, which in turn would require a long-term perspective.

Of course, there are other positive and negative factors affecting Poland's socio-economic condition and its prospects. Given Poland's current situation, the most important thing would be to draw proper conclusions from the historical lessons and also from errors committed in other countries (following the principle: "learn from the mistakes of others, and you won't have time to make our own"). It is also important not to waste Poland's potential, and especially human and intellectual resources, which are the most valuable. Two centuries ago, during the period when Poland was under foreign rule, Polish poet and geographer Wincenty Pol said: "You praise the foreign and ignore your own, you do not know what you own," and unfortunately this reflection still seems to be valid. At about the same time, Juliusz Słowacki, another great Polish national poet Wincenty Pol (1807-1872), wrote of his country: "You were the nations' peacock and parrot / Now you are a handmaid of other peoples." [Pol. W, "*Kraj*..]. Currently, Poland stands a great chance of making these bitter, historical reflections obsolete. However, this largely depends on the effectiveness of long-term socio-economic policy, which is far from being right. Hence the importance of actions aimed at rationalizing the political and governance systems. While transnational regulations (including those adopted in the EU) seem favourable, of decisive importance is the model of socio-economic system existing in a particular country. Despite the provisions of the Polish Constitution (Article 20) and of the Treaty (Constitution) of the European Union stating that the model to be pursued is the social market economy aimed at balancing economic and social progress, the adopted objectives have not been achieved in this matter, which is a barrier to the development of a civilization of knowledge and making wise use of it.

A CIVILIZATION OF KNOWLEDGE VERSUS A CIVILIZATION OF WISDOM

The notion of a civilization of knowledge, just as that of a knowledge-based economy, is controversial and treated by many scholars as not very precise. Man's actions (not only economic ones) have always been guided by some knowledge. But over the past few decades, the above notions have come to be regarded as the central concepts used to describe the modern world. A civilization of knowledge and a knowledge-based economy are such categories in which knowledge becomes a "universal substitute" shifting other elements of the productive potential into the background. Today, knowledge has become a kind of universal "machine tool" whose immense potential has been spectacularly proved by the genesis and development of such businesses as the Google search engine and the Facebook social networking service.

At the same time, one of the most embarrassing faults of the civilization of knowledge seems to be, paradoxically, a growing dichotomy between knowledge and wisdom, as it was already

mentioned. This dichotomy was quite bluntly exposed by José Ortega y Gasset in his timeless 1929 book entitled *La rebelión de las masas* (*The Revolt of the Masses*): "The characteristic of the hour is that the commonplace mind, knowing itself to be commonplace, has the assurance to proclaim the rights of the commonplace and to impose them wherever it will" (Ortega y Gasset, 2002, p. 15). Indeed, there are signs that the said "hour" is still going on. Despite the unprecedented and unquestionable progress in knowledge, science, and technology, knowledge has not been satisfactorily translated into social welfare. One of the manifestations of the substitutional potential of knowledge is, unfortunately, also the substitution of knowledge for reason. This process is taking place despite the fact that knowledge is rapidly aging given the ongoing, increasingly dynamic changes and that badly used and badly managed knowledge can lead to disaster. The consequences of the absence of wisdom in the use of knowledge may be indeed disastrous. This has been proved by numerous highly undesirable processes and actions that can spread in an amazingly easy manner, demonstrating the absence of reflection, wisdom, responsibility, or long-term prudence in low and high ranking decision-makers, including those on the top.

A globally punctuated ecological, economic, demographic, and political equilibrium is both a symptom and a result of the deficit of wisdom (Thurow 1999, p. 17).

Today's dysfunctions in the use of knowledge are the subject of many analyses, the number of which has surged in the aftermath of the global crisis that began in the US in 2007–8. One of them is the latest book by John C. Bogle, *Enough. True measures of money, business and life*, and another Joseph Stiglitz's *Freefall: America, Free Markets, and the Sinking of the World Economy* (these books have been translated into Polish and published by the Polish Economic Society). These publications highlight the existence of areas of menacing disequilibrium in the modern world generated under the paradigm of the knowledge-based economy and the neoliberal doctrine with its inherent short-termism, or "the terror of short-term earnings" (Stiglitz 2010, p. 320 et seq.).

This is further aggravated by dysfunctions in the measurement of knowledge and the economic results and standing of companies. Paradoxically, although this is a fundamental issue both in economic theory and practice, there are many contentious issues, irregularities, and even distortions leading to the misrepresentation of economic performance. These weaknesses are manifest at all levels of economic activity, including the measurement of gross domestic product—the most synthetic metric of economic output. By the nature of things, all problems connected to the measurement of business results add up in GDP. The global crisis is a spectacular manifestation of the irregularities in the measurement of business performance partially caused by a distorted image of the business standing and results of companies, especially those in the financial sector. This found dramatic expression in a report by the US Senate Commission investigating "the anatomy of a financial collapse," prepared and published in April 2011 under the direction of Carl Levin and Tom Coburn (*Wall Street and the Financial Crisis* 2011). The report states that a key role in the outbreak of the financial crisis was played by the investment bank Goldman Sachs. Its actions call into question the entire system underpinning the functioning of Wall Street. The bank has been criticized in very harsh terms and its products have been compared to "chips in a giant casino." Many well-known economists, including member of the British House of Lords Robert Skidelsky (2009), explicitly say that the global crisis was the result of large-scale irregularities and erroneous appraisal of assets by private banks and rating agencies.

The dominance of "externality" in the measurement of value, the dominance of herd behaviour, actions guided by imitation, and the marginalization of the "internal" foundations of value are becoming a characteristic trait of our times, where glitz and superficiality prevail over deeper reflection, insight, or even responsibility. This also applies to the valuation of businesses, as evidenced by the well-known principle that "a company is worth as much as a potential buyer is willing to pay for it." In his 2009 book published under the provocative title *Why Not Socialism?* Professor of Political Philosophy Gerald Allan Cohen finds the fact that valuation of labour and products is exclusively conditional on the subjective assessment of the interested parties to be a major affliction of capitalism hindering the proper use of the potential of knowledge, and especially of intellectuals' creative capabilities and reflection (Cohen 2010, p. 93).This was also stressed by Rainer Hank in his somewhat ironic commentary to this book: "That is why in capitalism the highest salaries are not paid to even the wisest philosophers (and perhaps that's why so many of them have become socialists), but to people like Mark Zuckerberg, who dropped out of college to establish his 'social networking site'" (Cohen, 2010, Sozialismus,... p. 93)

German philosopher Peter Sloterdijk, referring to the dilemmas of understanding value, comes to the surprising conclusion that the real hero of our times is Harry Potter. "Well, the Harry Potter novels present a world without reality frontiers. This kind of primer has convinced a whole generation of readers to discover the wizard in themselves. Interestingly, the English word *potter* denotes *a pot-maker*, and that is a craftsman who produces hollow containers. Only losers today still believe in work, while the others try to do magical potter things and let their structure financial products fly" (interview with P. Sloterdijk 2009). This assertion, full of bitter irony, points out the risks arising from violations of proportion and an imbalance between profit and the amount of work put in. "It is this disparity that has left a stamp on the way people thought in the past decades. They wanted to escape the real world where most people got mediocre salaries working 40 hours a week while you could join the ranks of the super-rich by doing some magic for a couple of hours. Thus, we have invented a dangerous mode of computing. Commonplace equations have been replaced by extravagant arithmetic. This ruins the sense of adequacy. Our understanding of cause and effect relationships and a sense of proportion have been destroyed" (ibid.).

Economists are also accused of misinterpreting the works and ideas of Adam Smith to the effect that the market actors are exempt from the requirement of moral reflection. If pursuit of one's own selfish interests—led by the invisible hand—ultimately results in social welfare and the "wealth of nations," then all that we must care for and all that we should do is to make sure that we are pursuing our own interests. This approach results in the marginalization of the moral and ethical aspects of economic life, which in turn is a source of various forms of destruction and disequilibrium. Entities with excessively confrontational attitudes may precipitate undesirable phenomena and threats, especially that competition often stops short of destruction. Unfortunately there is ample evidence that the same can be said of knowledge and destruction. If knowledge is not to be used destructively, it must be accompanied by wisdom.

The above seems to fully corroborate the postulate made long time ago by Antoni Kukliński at the Forum of Strategic Thought held by the Polish Economic Society (Kukliński 2011, pp. 65–68) to shift from a paradigm of knowledge-based economy to a paradigm of wisdom-

based economy. Kukliński wrote: "I would like to formulate a controversial postulate that the old paradigm of knowledge-based economy be creatively destroyed and replaced with a new paradigm of an economy based on wisdom. . . . In formulating the postulate to creatively destroy the old paradigm, we do not seek to denounce the great achievements of the knowledge-based economy between 1990 and 2010. Indeed, these achievements have provided the foundation for creating a new incarnation of the knowledge-based economy of the 21st century. However, these achievements are not a sufficient condition for us to successfully encounter the 21st century enigma. . . The epitaph of the old paradigm of knowledge-based economy should be the subject of fascinating and controversial academic reflection, which carries a great potential of innovative solutions in the process of encountering the 21st-century enigma. Albert Einstein's observation that 'imagination is more important than knowledge' should be interpreted anew" (ibid.). It cannot be excluded that the postulate to shift to a new paradigm may be regarded as purely verbal effort because it does not indicate tools for operationalization. However, even a verbal approach to this problem is important as words have strength in their own right and can become deeply ingrained in the mind. This is an appeal to dare to be wise. The validity of such an appeal cannot be questioned. Even if it is regarded as a utopia, it is certainly a highly useful one. Therefore, it will not remain without an impact on reality. The postulate to replace the paradigm may constitute an important beginning of a debate on the rationalization of the model of social development" (Kukliński 2011; Mączyńska 2011).

In the face of global dysfunctions in the civilization of knowledge, Poland, thanks to its "backwardness rent," has a chance to "leapfrog" this model of civilization and arrive at the stage of the civilization of wisdom. This would allow Poland to use its potential in an optimum way, without the dysfunctions and abuse characteristic of the more developed economies in this respect.
Antoni Kukliński's postulate to replace the paradigm of knowledge-based economy with wisdom-based economy corresponds to the "Wise Poland" decalogue for knowledge-, skill-, and entrepreneurship-driven society announced by Michal Kleiber in February 2011. The decalogue comprises of 10 postulates, the implementation of which should form the foundations for a strategy of the country's innovative development (interview with M. Kleiber 2011).

PARADIGM OF WISDOM-BASED ECONOMY AND ECONOMIC ORDER

The global economic collapse triggered by the financial crisis has not only stimulated discussion about the legitimacy of the financial system in its present form, but also intensified the ongoing debate on the future of capitalism, the role of the state, and the best socio-economic system to promote social and economic welfare. Therefore, an open question remains as to what kind of strategy and economic system would promote social rationalization. Despite theoretical disputes about the economic system, the principle of competitiveness remains unchallenged. However, the dogma of free market and free market competition leads to its distortion and limitation.

Due to the overwhelming scale of punctuated equilibrium and its complex global consequences, we still lack convincing concepts and strategies to solve this problem. Strategic reflection is a necessary condition for the shift from the paradigm of knowledge-based economy to the wisdom-based paradigm, which has been postulated in the face of the

dysfunctional civilization of knowledge. In a situation of increasing global uncertainty, this reflection should be aimed at identifying the main threats to the development of civilization, such as the consequences of global disequilibria in many areas (including the demographic, environmental, and financial spheres).

When the world is unpredictable and full of "black swans," strategic reflection should primarily focus on the identification of the main development trends and, most importantly, on the least predictable areas of risk.

Analyses of the global turbulence point to errors in the economic system policy. For example, Nouriel Roubini underscores that the crisis will determine future solutions, creating a tomorrow with a specific economic system.[1] Hence, the still open question about the optimal shape of the economic system and the future of the Anglo-Saxon neoliberal laissez-faire model of capitalism that predominated prior to the global crisis (ibid., p. 4). The literature stresses the need for systemic changes aimed at reducing the risk of crisis-like threats. Renowned German economist Peter Bofinger wonders whether it is possible to save the free market model of economy and why it is now necessary to have a strong state (Bofinger, 2010).

Currently, increasing emphasis is given to the argument that the primary sources of dysfunction in a knowledge-based economy largely lie in systemic errors, such as the uncritical acceptance of the neoliberal doctrine in economic system policy making. Characteristically, such opinions are shared also by those who until recently advocated that doctrine. One of them is Jeffrey Sachs, who argues that: "We were trapped between two voluntaristic utopias. One of them sanctifies the market and the other—society. The majority of people were led to believe that the government could not help them, and even if it promised to do so, it would still waste everything. Now much time will pass by the time they realize anew that there can be neither good society nor an efficient economy without a strong state" (interview with J. Sachs 2009). A similar opinion is expressed by Bofinger (2010), who stresses the importance of an efficient balancing of the roles of the state and the market in the economy.

On the other hand, Maciej Bałtowski (2009, p. 7) observes how capitalism is dangerously evolving towards socialism, which brings to mind the argument of Joseph Schumpeter (1942) about the transition of capitalism into socialism. However, as opposed to Schumpeter, who said that capitalism was not going to survive and the ongoing transformation of capitalism into socialism was determined not by its failures but by its successes, Bałtowski points out to capitalism's failures. He says that "over the last several dozen years free market capitalism has been evolving towards a system incorporating certain characteristic features of the socialist economy, even though this peculiar evolution may have been hard to notice at a first glance" (Bałtowski 2009, p. 2), which is manifest in the "doctrinal foundations of the economic system." At the same time, Bałtowski warns that too much faith has been put in the dogma of global regulation of the economy. He states that certain general conclusions should be drawn from the experience of the socialist economy concerning the way the global

[1] "In fact, we believe that understanding and managing crises requires a more holistic and eclectic approach than is perhaps customary. It's necessary to check ideology at the door and look at matters more dispassionately. Crises come in many colors, and what works in one situation may not work in another."—From the introduction to Nouriel Roubini's book (2009, p. 6).

regulators function. First of all they should focus their activity not on substituting the market—which always leads to various adverse effects—but on reducing market failure. If the global regulator is convinced of its wisdom and omnipotence and does not curb its constructivist inclinations and excessive anthropological optimism, it will doubtlessly end up in a position similar to the central planner in a socialist economy. The only way out, it seems, is to let the global regulators act in accordance with the logic of the market or "marktkonform," as it is proposed by the German theory of the social market economy.

This assumption is all the more important because it refers to the constitutional model of the Polish economy, that is, the social market economy. In view of the dysfunctions of the political and economic order which have emerged in the wake of the global crisis, the idea of the social market economy becomes even more attractive. It is founded on ordoliberal theory, which in turn refers to the notion of "ordo," dating back to the ancient *Imperium Romanum.* The essence of the notion lies in designing an order which would suit the human nature and ensure economic sustainability. The current financial crisis has to some extent proven the relevance of the social market economy. Characteristically, the crisis has hit the mightiest markets of the capitalist world, and primarily the USA and Great Britain, while countries with the so-called Nordic economic system, using the social market economy in practice, have been less affected and "politicians from both right and left could learn from the Nordic countries" [*The Nordic countries.The next supermodel*, 2013, p. 11]

Although opinions on the social market model of economy are quite controversial, analysis of its features indicates that it offers a chance to lay solid foundations for the coherence and sustainability of social and economic development. The social market economy is characterized by holism, or comprehensive consideration of the individual components making up the extremely complex structure of the political and economic order. However, a prerequisite for the effective implementation of the ordoliberal concept of the social market economy is its adjustment to the ongoing unprecedentedly dynamic technological, social, and economic changes, including globalization.

CONCLUSIONS

The "punctuated equilibrium" and volatility, so characteristic of the modern-day world, force us to seek new theoretical concepts and solutions focused on accessing the civilization of knowledge. Priorities include reduction of the dichotomy between knowledge and wisdom and a symbiosis of economic, social, and ecological development. A model for such a symbiotic approach is provided by the principles of the social market economy. They are not new, but their relevance seems to be more and more apparent in the light of the current developments. But also this model needs to be adjusted to the changing economic conditions, and to the (partially globalization-driven) shifts in power and decision-making competence.

Future will show whether and to what extent the holistic concept of the social market economy turns out to be useful. Instead of offering a straightforward answer, I will respond with Thurow's question "How is a capitalistic system to function in a brainpower era when brainpower cannot be owned?" (Thurow, 1999, p. 29).

Such an approach to this issue entails further questions: "What model of a political and economic order would be best suited to the optimum use of brainpower?" and "What role in

this process of change is to be played by economic theory and particular 'economic schools'?" These questions are the more important as economic theory and economists are blamed for the dysfunctions of the economy and for not having predicted and prevented the present crisis.

These are open questions for further reflection and discussion. The necessity of such a discussion—taking into consideration some futurological reflection—is becoming increasingly apparent. Even though Fukuyama's notion of "the end of history" and the neoliberal doctrine by definition marginalize futurism, leaving the future to be regulated by the free market mechanism, it seems that now—given the world's problems—the need to think about the future and act for its sake as well as the need to embrace a strategic thinking culture are gaining increased recognition. Today Francis Fukuyama no longer stands so firmly by his convictions, critically assessing the "foreign finance fetish," saying that "one of the paradoxical consequences of the 2008–9 financial crisis may thus be that Americans and Britons will finally learn what the East Asians figured out over a decade ago, namely, that open capital markets combined with unregulated financial sectors is a disaster in the waiting" (Fukuyama 2011).

In the context of Poland's economy, civilizational development requires wise strategies and a wise socio-economic system that would ensure holistic reconciliation of economic, social, and environmental issues.

REFERENCES

1. Bałtowski M. (2009), *Gospodarka socjalistyczna w Polsce. Geneza, rozwój, upadek* [Socialist economy in Poland: Genesis, development, and fall], Wydawnictwo Naukowe PWN, Warsaw.
2. Beck U. (2002), *Społeczeństwo ryzyka. W drodze do innej nowoczesności* [Risk society: Towards another modernity], Scholar, Warsaw.
3. Bofinger P. (2009), *Ist der Markt noch zu retten? Warum wir jetzt einen starken Staat brauchen* [Can the market be still saved? Why do we now need a strong state], Econ Verlag, Düsseldorf.
4. Bofinger P. (2010), "Czeka nas epokowa zmiana" [Up for an epoch-making change], *Forum*, no. 32.
5. Bogle J.C. (2009), *Dość. Prawdziwe miary bogactwa, biznesu i życia* [Enough: True Measures of Money, Business, and Life], PTE, Warsaw.
6. Cochrane J.H. (2009), *How did Paul Krugman get it so Wrong?*, http://modeledbehavior.com /2009/09/11/john-cochrane-responds-to-paul-krugman-full-text, 11 September 2009.
7. Cohen G.A. (2010), *Sozialismus. Warum nicht?* [Why not Socialism?], Albrecht Knaus Verlag, Munich..
8. Fukuyama F. (2011), "Nie stać nas na kapitalizm" [We can't afford capitalism], *Forum*, no. 17/18.
9. Gomułka S. (2009), *Krugman, diagnozując przyczyny kryzysu, pomija znaczące zjawiska* [In diagnosing the causes of the crisis, Krugman overlooks important phenomena], http://www.obserwatorfinansowy.pl/2009/10/15/wywiad-z-prof-gomolka/?k=debata.
10. Hampden-Turner C. and Trompenaars A. (1998), *Siedem kultur kapitalizmu* [Seven Cultures of Capitalism], Dom Wydawniczy ABC, Warsaw..

11. Interview with A. Negri (2010), "Marks by się uśmiał" [Marx would have a laugh], *Forum* 2010, no. 4.
12. Interview with J. Sachs (2009), *Polityka*, 19 January 2009.
13. Interview with M. Kleiber (2011), *Prof. Kleiber zaprasza do debaty nad "Mądrą Polską"* [Prof. Kleiber invites debate on "Wise Poland"], 15 February 2011, http://www.naukawpolsce.pap.pl/palio/html.run?_Instance=cms_naukapl.pap.pl&_PageID=1&s=szablon.depesza&dz=MADRAPOLSKA&dep=379758&data=&lang=PL&_CheckSum=-639034386.
14. Interview with P. Sloterdijk (2009), "Ratunek nie przyjdzie z góry" [Rescue will not come from the top], *Forum* 2009, nr 14.
15. Interview with R. Frydman (2008), "Ekonomia niepewności" [Economics of uncertainty], *Polityka. Niezbędnik Inteligenta*, no. 14, 8 March 2008.
16. Kleer J., Mączyńska E., and Wierzbicki A., eds. (2009), *Co ekonomiści myślą o przyszłości* [What economists think about the future], PTE, Warsaw.
17. Krugman P. (2008), *The Return of Depression Economics and the Crisis of 2008*, W.W. Norton & Co Inc., New York.
18. Krugman P. (2009a), "How Did Economists Get It So Wrong?," *New York Times*, 2 September 2009.
19. Krugman P. (2009b), "It's the Stupidity Economy," *The Conscience of a Liberal* (blog), http://krugman.blogs.nytimes.com, 13 November 2009.
20. Kukliński A. (2008), *Problematyka przyszłości regionów. Piętnaście komentarzy. W poszukiwaniu nowego paradygmatu* [The future of regions: Fifteen commentaries; In search of a new paradigm], http://www.mrr.gov.pl/Aktualnosci/Polityka%20regionalna/Documents/1561d8db763b4367a323cca68d4cc62dProblematykaPrzyszociRegionw15komentarzyWposzukiwa.pdf, 15 March 2008.
21. Kukliński A. (2011), "Od gospodarki opartej na wiedzy do gospodarki opartej na mądrości. Na spotkanie z enigmą XXI wieku" [From the knowledge-based economy to the wisdom-based economy: Encounter with the enigma of the 21st century], *Biuletyn Polskiego Towarzystwa Ekonomicznego*, no. 2.
22. Leith W. (2009), "Still looking for a free lunch," *Guardian*, 27 December 2009.
23. Lucas R. (2009), "Robert Lucas on economics," *Economist*, 6 August 2009.
24. Markiewicz H., ed. (2001), *Cytaty mądre i zabawne* [Wise and funny quotes], Wydawnictwo Literackie, Cracow.
25. Mączyńska E. (2011), "Dychotomia wiedzy i mądrości. Komentarz do tekstu Antoniego Kuklińskiego pt. Od gospodarki opartej na wiedzy do gospodarki opartej na mądrości. Na spotkanie z enigmą XXI wieku" [The dichotomy of knowledge and wisdom: A commentary to Antoni Kukliński's "From the knowledge-based economy to the wisdom-based economy: Encounter with the enigma of the 21st century"], *Biuletyn Polskiego Towarzystwa Ekonomicznego*, no. 2.
26. Ortega y Gasset J. (2002), *Bunt mas* [The Revolt of the Masses], Muza, Warsaw.
27. *PlanEcon Monthly Report. Developments in the Economies of Central Europe and Russia* (2010), IHS Global Insight, Lexington, Mass., vol. XXV, no. 13-14.
28. Pol W. "Kraj ojczysty" ["Fatherland"], http://www.glowy.bydgoszcz.pl/boguccy/wincenty_pol.htm.
29. Ritzer G. (1999), *Makdonaldyzacja społeczeństwa* [The McDonaldization of Society], Muza, Warsaw.
30. Roubini N. (2009), "Laissez-Faire Capitalism Has Failed: The financial crisis lays bare the weakness of the Anglo-Saxon model," *Forbes*, 19 February 2009.

31. Roubini N. and Mihm S. (2010), *Crisis Economics: A Crash Course in the Future of Finance*, Penguin Press, New York.
32. Roubini N. and Mihm S. (2011), *Ekonomia kryzysu* [Crisis Economics], Wolters Kluwer Polska, Warsaw.
33. Rushe D. (2011), "Jeszcze jedna bańka? Mikroblogowe kopalnie złota" [A new dotcom bubble? Microblogging gold mines], *Forum*, no. 9.
34. Sachs J. (2013), **"**The Price of Civilization: Reawakening American Virtue and Prosperity", Random House, NY,
35. *Science, governments and business working together to meet the challenges of our time Future Dialogue – An international conference of leading experts and decision-makers in Berlin on October* 26 (2009), Berlin 26 October 2009, http://w1.siemens.com/press/pool /de/pressemitteilungen/2009/corporate_communication/axx20091005e.pdf.
36. Skidelsky R. (2009), "Keynes versus the Classics: Round 2," Project Syndicate, 13 October 2009, http://www.skidelskyr.com/site/article/keynes-versus-the-classics-round-2.
37. Skidelsky R. (2011), "Democracy or Finance," Project Syndicate, 18 April 2011, http://www.skidelskyr.com/site/article/democracy-or-finance.
38. Sloterdijk P. (2009), *Du mußt dein Leben ändern. Über Anthropotechnik* [You must change your life: On human engineering], Suhrkamp Verlag, Frankfurt am Main.
39. Stiglitz J.E. (2010), *Freefall. Jazda bez trzymanki. Ameryka, wolne rynki i tonięcie gospodarki światowej* [America, Free Markets, and the Sinking of the World Economy], PTE, Warsaw.
40. Sztaba S. (1994), *Ekonomia niekonwencjonalna* [Unconventional economics], Read Me, Warsaw.
41. Taleb N.N. (2007), *The Black Swan: The Impact of the Highly Improbable*, Random House, New York.
42. Tapscott D. and Williams A. (2008), *Wikinomia. O globalnej współpracy, która zmienia wszystko* [Wikinomics: How Mass Collaboration Changes Everything], Wydawnictwa Akademickie i Profesjonalne, Warsaw.
43. The Nordic countries.The next supermodel, The Economist, 2013, Feb. 2nd,
44. Thurow L.C. (1999), *Przyszłość kapitalizmu: Jak dzisiejsze siły ekonomiczne kształtują świat jutra* [The Future of Capitalism. How Today's Economic Forces Shape Tomorrow's World], Wydawnictwo Dolnośląskie, Wrocław.
45. Toffler A. (2000), *Szok przyszłości* [Future Shock], Zysk i S-ka, Poznań.
46. Toffler A. (2003), *Zmiana władzy. Wiedza, bogactwo i przemoc u progu XXI stulecia* [Powershift: Knowledge, Wealth, and Power at the Edge of the 21st Century], Zysk i S-ka, Poznań.
47. Toffler A. and Toffler H. (1996), *Budowa nowej cywilizacji. Polityka trzeciej fali* [Creating a New Civilization: The Politics of the Third Wave], Zysk i S-ka, Poznań.
48. "Towards a sustainable future" (2009), *Economist*, 5–11 December 2009.
49. Veblen T. (2008), *Teoria klasy próżniaczej* [The Theory of the Leisure Class], Muza, Warsaw.
50. *Wall Street and the Financial Crisis: Anatomy of a Financial Collapse* (2011), United States Senate, Committee on Homeland Security and Governmental Affairs, Permanent Subcommittee on Investigations, Washington 13 April 2011.
51. "What Went Wrong with Economics. And How the Discipline Should Change to Avoid the Mistakes of the Past" (2009), *Economist*, 16 July 2009.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

ENHANCING PROJECT MANAGEMENT – A QUALITY GATE USAGE

Saroj Koul, Jindal Global Business School, India
Email: skoul@jgu.edu.in

J. Joshuva Alexander, Jindal Global Business School, India
Email: 11jgbs-jjalexander@jgu.edu.in

ABSTRACT

Purpose: *In most companies achieving or delivering quality product or service becomes a complex task especially when setting up a new production process; every time focusing on project completion, meeting deadlines and quality check at the end of the production.*

Two types of quality checks can be applied to reduce the complexity of the project, i) quality control (QC) - which is established for monitoring and continuously check the output and performance of a product at an operational level, and ii) quality management gates (QG) – which are used for decision making that impacts the outcome of the project.

Among these two concepts QG concept is one of the most established approaches to address the described quality issues. In this paper, we attempt to explain QG with an example to understand the supportive tools that are required for a successful implementation of quality gate at the project execution phase.
Design methodology/approach: *The approach described in this case conceptualizes the process of implementation of quality gate to manage the quality performance of the project process flow.*
Research limitations: - This specific time bound research is limited to the implementation of QG only since development of the electronic quality gates needed sufficient time to validate for including the corrective measures after feedback was received to come to the desired outcome of the research.
Research implications: *The findings of the exploratory study can offer valuable insights and recommendations as how the quality gate can be implemented, its necessary supportive tools, how to go about into electronic format, and its benefits.*
Originality/value: *This conceptual research provides comprehensive idea to implement the quality gate in projects by step-by-step procedures to have the best quality management to evaluate and deliver the best project to the customer. It provides immense idea to other researchers and industrialists to choose a right quality management tool.*

Key words: Project Management, WBS, Scheduling, Quality Gate, QG, Business Process Management.

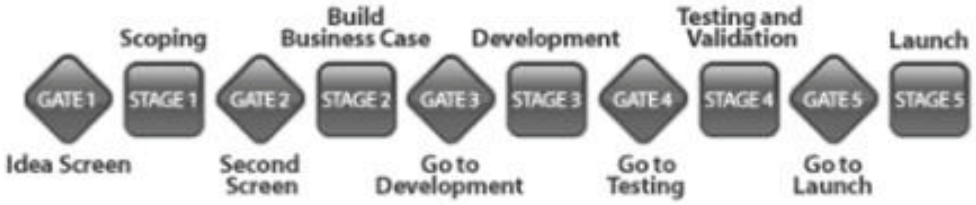
INTRODUCTION

Based on various obervations, and ideas collected from a group of firm managers, In 1986, Robert Cooper proposed the of stage-gate model, to help the firms to reduce the failure posibilities in the product development process, which would help the firm managers to devlier a desired quality product (Cooper, Winning at New Products, 1986). Later in 1960s, NASA implemented "phase review process" which is more alike to stage-gate model which is developed by Cooper (12Manage, 2007), (Cooper, Third-generation new product processes, 1994). There are three different gate process were identified and by the industrial experts to enhance the quality outcome of a project. They are i) Stage Gate, ii) Process Gate and Quality Gate.

1. Stage-gate

For development of product process, state-gate model is the powerful tool, which gives a well-structured and well-organized flow in the project. In stage gate, the project is splits into series of "Stages" and "Gates" as shown in the figure 1. The stages include a) scoping, b) build business case, c) development, d) testing and validation and e) launch of the final product.

Figure 1: Stage-Gate Process



Source: (Stage-Gate:Your Roadmap for New Product Development)

The Stage-gate model increases the work commitment to the assigned project and it also helps to eradicate bias in process validation, between the human conscious or subconscious prediction and confirmation. A stage-gate model can be used as a guide to formalize a model for the entire process to fulfill the desired objective of the project by break down the project into number of possible process to identify and analysis the new suitable process ways and provides new ideas for the further business improvement. In case of non-satisfactory level on increasing levels of commitment, the particular process has to be evaluated and act as a backward feedback loop for more analysis (Barringer & Gresock, 2008).

2. Process Gate

The Process Gate approach is related to the project management, decision making process and the continuous work flow to endorse quality. It is used to address the defect at process stage so that same defect should not be passing that manufacturing station.

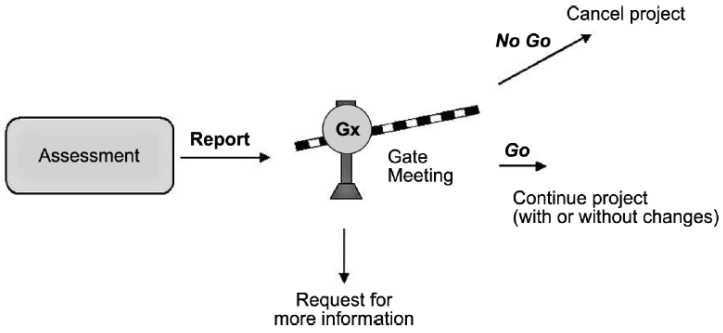


Figure 2: Process Gate
Source: (Chao & Ishii, 2004)

3. Quality Gate

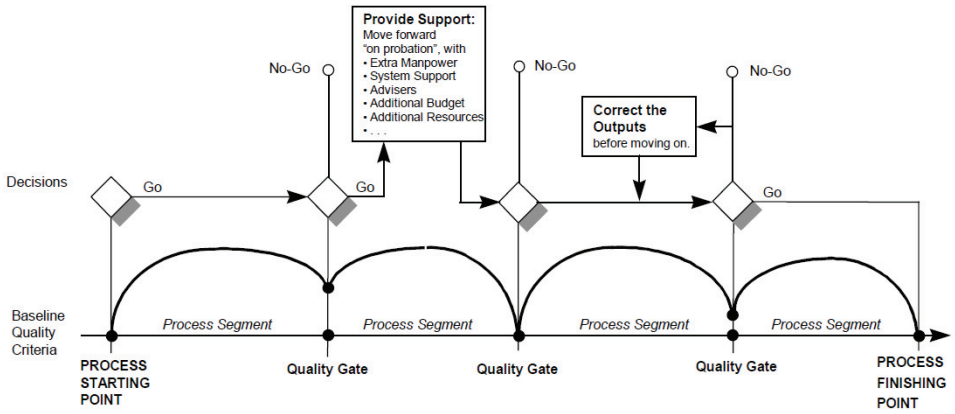


Figure 3: Quality Gate process
Source: (Introduction to Quality Gates, 1998)

A Quality Gate (QG) interfaces between project steps having a collection of quality completion criteria. The QG would be the defined phases and activities between the breakdown of the project work as shown in the figure 3. Each activity has to be passed through the QG for the release for next project activity, by gone through the evaluation of the previous process by means of fixed criteria. It has a check list of items involved in an activity of a project. Also at QG, detail analysis of defect, present status for defect etc. is also displayed.

TYPES OF QUALITY GATES

There are two types of QGs which are defined for different purposes to make control of the quality at operating level and at management level, namely Quality Control Gate and Quality Management Gate (Introduction to Quality Gates, 1998).*Quality Control Gate* are used for monitoring the product quality performance and outcome of the product within the operations process. Here the operational process of a product is divided in to number of possible activities, at the end of the each activity the product passes through the quality check. *Quality Management*

Gate are established for the decision making process which will control the outcome of the project with the desired quality. Here the project is divided in to number of possible activities such as designing, drafting, production, finishing according to the fixed target, timeframe and deadline. At the end of the each activity the product passes through a list of quality criteria which defines the specified output performance specifications, from this at management level decisions will be made to assure alignment between performance and expectations of the final outcome of the project.

CONVENTIONAL QUALITY CONTROL METHOD AND THE QUALITY GATE

Time, cost and quality are the three project management constraints; each is interrelated and impacts with one another. Among these three constraints, quality aspect is something tangible to inspect and becomes the issue at the last stage of any project and affects the whole process time as well the cost involved. There are other quality controls tools such as six sigma, kaizen (continuous improvement), statistical process control (SPC), quality assurance (QA), process capability index, etc. but these tools become most probably towards the final inspection stage. Of course inspection is one of the quality check point but it doesn't reduce the quality problems at the process stage, rework, time and cost incurred. To avoid this (Edwards, 1986) and (Juran & Gryna, 1980) enlightened the concepts of x of quality by mass inspection is not economical because it permits wasteful practices and it should be more economical to do things right the first time. The project planning and control tools offers little help to manage quality and also very few specific tools are there to help the project manager in terms of scheduling, monitoring and control project quality as well the cost to integrate quality into project management process.
In a project, one has to first identify the various activities/major process involved and then breakdown the process/activities according to the major involvement by function area. This given a clear idea about the life cycle of the project and they identified the milestones which are accountable for meeting costs, time and quality criteria. Each milestone carries a sufficient criteria i.e. check list that helps the project manager to control the quality of the project lifecycle at the early stage (Aaron, Bratta, & D, 1993).

An innovation for an integrated organization is based on two approaches, product lifecycle roadmaps and QG. Roadmaps are a sort of project layout where multi-disciplinary groups of peoples involved as team with a guiding framework to achieve a common goal. Planning, Implementation, Knowledge management, Product life cycle are the four major steps to accomplish a cost effective task on time. These four steps provide guidance and structure to the project execution, and lead to project innovation by controlling these steps.

The next method, QG, is sourced from quality controlling and is a list of pre-defined quality criteria which has to be satisfied before each activity is passed to the next to continue. This QG is an opportunity of early intervention in the development stage of a business project activities and it avoids the error, changing requirements and communication problems between the customer and the supplier and QG acts a single like a traffic light system, with that the Project manager or project supervisor can easily identify the bottleneck of the project (Giebel, Esmann, Preez, & Jochem, 2008).

QG is the predefined quality acceptance criteria reviews that can be used throughout any project lifecycle. QG might involve more paperwork but still this strategic management tool is fully customizable. The clearance of one QG would leads to the passage of project to the next gate, unless the IT project manager and a senior executive reviews the problems occurred in that particular gate for the free flow process throughout the entire project. For example, the project manager of a large CRM project faced a problem during the product development phase. The flow of activities involved designing the architecture to configuring and customizing the CRM application by the developers. Since there was no database support and with unassigned IP address, the impact in project timeline was not correctly measured. If the project manager had utilized the QG processes, he could have detected much earlier at the design phase the timeline of the project. Hence, QG needs to be integrated with both the development & deployment process of an IT projects. IT companies such as AT&T, Lucent Technologies and others have implemented QG successfully for their project development cycle (Charvat, 2003).

The implementation of QG requires some basic supportive project management tools like work breakdown structure, product breakdown structure and scheduling tools to stream line the QG approach into a project. Let's see how these supportive tools contribute the effectiveness for the implementation of QG.

PROJECT MANAGEMENT

Project management is the basic requirement for planning; organizing, managing, leading, controlling and monitoring the available resources like raw materials, time, money, manpower etc. so as to achieve the specific goals. Scope, time, budget and quality are the key challenge to achieve all the project goals. These constraints could be optimized by adopting predefined project management tools. Figure 4 shows the flow of project management process involved in any project.

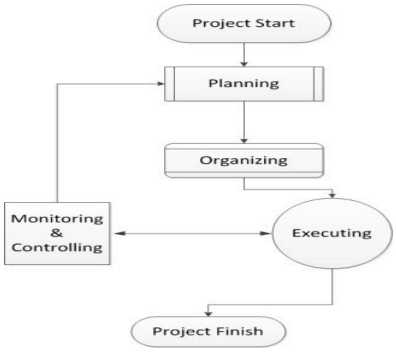


Figure 4: Project management process flow chart

Projects should have a continuous improvement in the project management process for the longer run and the project management has to be integrated and should relate with the goals of an organization. Also the time and resources allocated for project may be limited, so the maximum utilization of these time and available resources guarantees the project success (Ayas, 1997) and (Bachy & Hameri, 1997).

Project management practices helps to avoid the interdependencies of under-recognized and under managed work tasks and promotes "one time event" that increases the ongoing performance improvements by minimizing the inter-relationships between individual work tasks and other project mechanisms. A unified project management approach emphasizes the required project information to pass to all the project participants and provides a unifying influence in the continuous flow of work without any distractions or confusions in the path of continuous improvement of a project (Froese, 2010). In addition to that the project management defines the time period and cost required to complete the project and deliver the product on time. The tools like cause and effect diagrams, delay analysis would give the gaps where the process has to be strengthened (Chao & Ishii, 2004).

Additional tools such as WBS, Gantt chart, Critical Path Method (CPM), SWAV (used to identify the bottlenecks or conflicts during the entire scheduling period) and PERT technique are the supportive tools for the efficient outcome for a QG.

1. Planning

Work break down structure (WBS): The breaking down of a single task into multiple levels of tasks to reduce the complexity of the process and to speed up the project to complete with the desired quality on time is defined as Work break down structure. As such, the task is broken into several possible small tasks and provides a clear cut idea about the whole process of the project and reduces the complexity in it. Work breakdown structure provides a set of criteria for distinguishing between the hierarchical levels. It is an influential tool for a successful organization (Ayas, 1997). WBS has to be the first plan of any project, and then a detailed study has to be carried out about the product and the project site. Product breakdown structure, assembly breakdown structure (ABS) and organizational breakdown structure (OBS) are the basic structures used to derive an efficient work breakdown structure which are the required and necessary tools has to be prepared before initiating any project (Bachy & Hameri, 1997).

Product breakdown structure (PBS): PBS is an effective tool which categorized the complex components of a final product in a hierarchical form. It is similar to work breakdown structure. PBS comprises the complete product components list or sequence flow of product information represented in a data (tree) structure (figure 5) and also it comprises the technical description of manufacturing, machining, and quality control for all the all elementary parts (Bachy & Hameri, 1997).

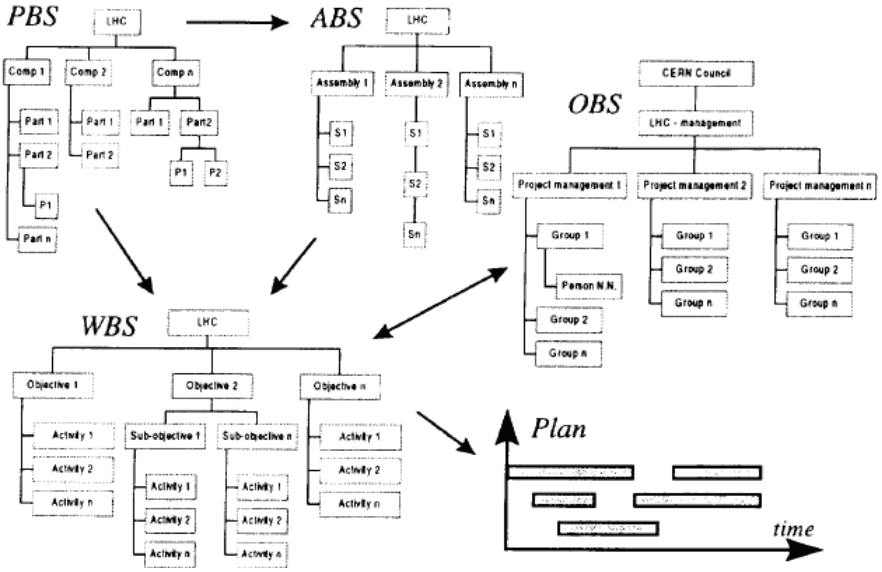


Figure 5: Preparatory process for a project [Source: Bachy & Hameri, 1997]

The main difference between product breakdown structure (PBS) and work breakdown structure (WBS) is that just product and work. The PBS entails the physical and functional elements of a product whereas WBS focuses on the number of works involved in a project. WBS is designed as per the PBS in any project along with that organizational breakdown structure (OBS) and assembly breakdown structure (ABS) are also took part in building a perfect Work breakdown structure (WBS). The figure 5 shows the clear picture about the implication of these three breakdown structures to arrive a perfect project plan.

2. Organizing

Project Scheduling: Project scheduling is the process of organizing and committing to decide, how to make use all the resources like manpower, time and budget between a varieties of possible tasks. It can be simply say that project scheduling is an established timetable consists of start and finish time of a project. Scheduling is mainly focus on time availability for a project and its maximum utilization to accomplish the task. The purpose of scheduling is to minimize the time and cost with the available resources like manpower, equipments, raw materials etc. to maximize the production efficiency. As per (Chen, Ling, & Chen, 2003), scheduling for a large project especially for a new product development (NPD) process is a challening task and requires potential knowledge and determination.

Scheduling can be done by two ways, forward and backward. Forward scheduling is to determine the time required to start the project to the end date or due of the project. In case of backward scheduling, it is just reverse of the forward scheduling, it determines the planning the tasks from due date of the project to the start date of the project. In QG approach forward scheduling is most likely in use. A schedule maker should have a well-designed work breakdown structure and product breakdown structure before start creating a project schedule; this would help the scheduler to create an effective estimate for each task with available resource list for each task.

Activity networks, Gantt Chart technique are the basic project scheduling tools and also scheduling could be done with the help of project scheduling software packages available in the market such as Microsoft project, Prime avira by Oracle, these two applications are the most user friendly and most efficient, apart from these two there are other software packages are available in the market such as Clarizen, Genius Project, Daptive PPM etc.

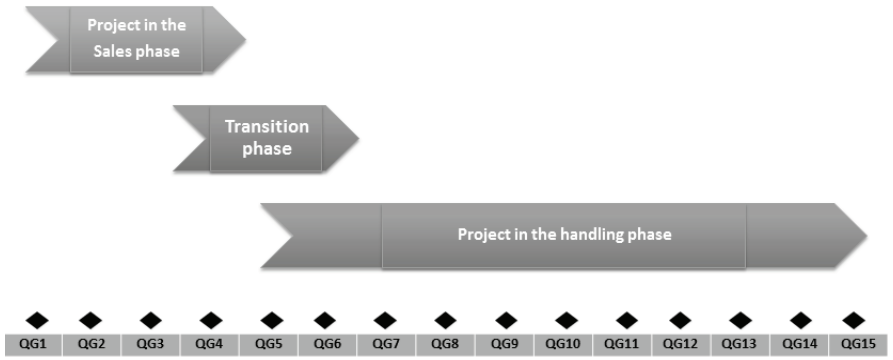
IMPLEMENTATION OF QUALITY GATE

A project is a plan or proposal for a desired goal and it has a group of activities which has a starting point and an end point and it deals with the 4M's (Man, Money, Material and Machine). While implementing a QG in a project, the project has to be broken into possible small activities. Per se a project could be divided into three [1]phases right from receiving a project from customer to the end i.e. delivering the product or service to the customer are like:

1. Sales (Order booking) Phase
2. Transition Phase
3. Order Handling Phase - Project definition, Design, Production, Equipment installation and Commissioning

In an overview a project consists of various activities to accomplish the task, parse there are fifteen activities involved right from customer enquiry to product delivery and commissioning of the project. These activities are divided into three phases i) sales, ii) transition and, iii) project handling. All the three phases has to be undergone through the QG. There are nearly fifteen QGs, in that first four QGs falls under the project sales phase, and the remaining eleven QGs falls under the project handling phase. As shown in the figure 6.

Figure 6: Overview of sales and order handling Quality Gate



Each stage has their unique activities to complete the task and transfer the project to the subsequent activities. For example the sales stage has the activities of customer inquiry, general conditions, specifications customer input), cost estimation & risk assessment (customer input) and negotiations. Once these sales activities are done then the sales department has to move the

[1 Phase: it's a separation of group of activities involved in a project]

project to the next process called project execution. In such a way the project has to undergone through the above said six stages to fulfill its destiny.

1. Quality gate in sales (order booking) phase

In sales phase covers right from getting an order to confirmation of the order until handover the order to the project execution phase to start the project. The QG in the sales phase has to be followed and recorded by the sales and marketing departments. The QG in the sales phase is clearly shown in the figure 7. If there is any issue in this part the order will not enter in to the project execution phase, so that no project has to be executed in the project execution phase without the clearance from the sales phase. This helps to avoid the loss of production in case of unconfirmed or un-clarified projects.

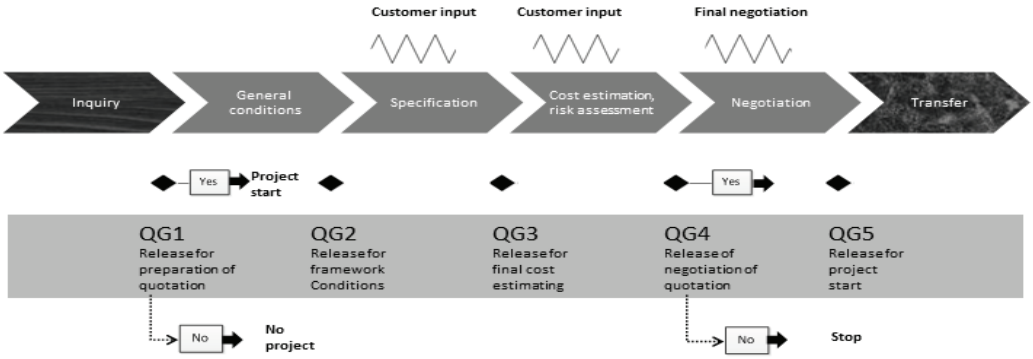


Figure 7: QG in project sales (order booking) phase

2. Quality gate in transition phase

Transition phase is just transferring the approved project to the production or manufacturing department with the required specifications, budget constraints, time frame and other documents. These documents also go through the gates to avoid the unnecessary confusion or unclear information to start a project. If the information is unclear then the project would not go for the project execution phase to start the project and it would be return to the sales department for the clearance.

3. Quality gate in order handling phase

The graphical representation of order handling phase is shown in the figure 8 which clearly explains the passage of different projects in the QG; here the QG from QG5 to QG15 are falls under the order handling phase. That is after the order has confirmed and passed through the QG in the sales phase the order has been released for the project start by the sales people to the project management people. In each and every quality a set of document called checklist regarding previous activity has been recorded and filed in the project folder for the further references. The light indicator in the figure signs the completion of QGs in that particular activity of the project, here the project has successfully passed up to the QG number 12. The QG 13 is

under process and the red sign indicates the QG14 and QG15 are yet to be completed. This helps to track the project whether it moves along with the schedule of the project. If any delay/problem occurs in a particular activity, it helps to find the solution easily and it eliminates the repetitive of work of the whole process. By referencing the previous QG was the projects had been passed through the project manager can easily identifies the location within a less time. That's why all the QGs must be documented in the folder once the project passed through that particular QG. The main advantage of this QG is that if any problem occurs in an activity the subsequent QG will not allow the project to move on to the next activity of the project. So the accuracy of the project can be achieved.

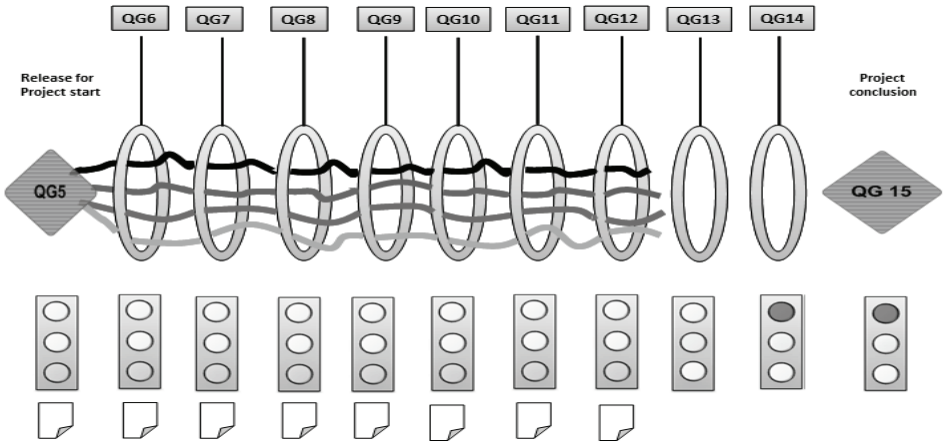


Figure 8: Overview of Quality Gate at project execution phase

4. Field and task-overlapping

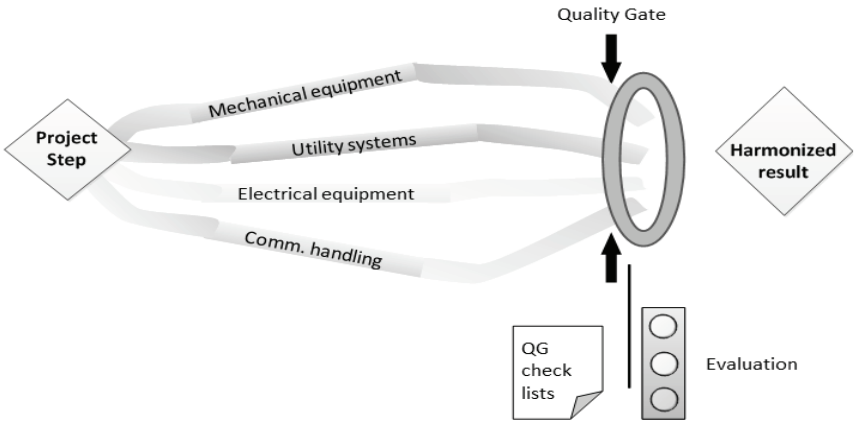


Figure 9: Field and task-overlapping

Each and every activity has some sub-activities to accomplish the particular activity of a project. The result of each activity would be a harmonized of different sub-activities. For example let's take an activity called detailing. This activity may be sub divided into basic engineering of mechanical equipments, electrical equipments, utility systems and commission handling, and

also for detail engineering of mechanical equipments, electrical equipments, utility systems and commission handling etc. The QG checklist has these sub-activities list for the evaluation to give a harmonized result of an activity.

QUALITY GATE NORMS

- As a rule, the QG must be applied in all projects for which SDE bears the overall project responsibility.
- In selected QG, section-specific items are contained as separate parts in the check lists.
- In small-scale projects it may be possible to skip certain QGs. The decision on this is taken by the project management in coordination with the project principal.
- The signed QG records must always be stored as .tif or .pdf files in the basic project folder of the respective project under "QG".
- When subsidiaries participate in the project, they shall be involved in the implementation of the QGs

PROCESS TO IMPLEMENT THE QUALITY GATE

The major steps in the process to implement the QG include: First - build a WBS with a Product breakdown structure (PBS) and Assembly breakdown structure (ABS); Next prepare a complete time schedule with the available resources and budget; Thirdly, set up the QG criteria; Fourth, train project team members; Fifth, implement QG, and finally take corrective actions.

BENEFITS OF QUALITY GATE

Some of the major benefits of QG include: helps project manager to take a quick decisions, avoids the poor or underperformed ideas in the path of continuous project improvement, provides product success with the desired quality and prevents the poor outcome and redirects to corrective actions; increase the participation and motivation of employees towards the project goal, reduces the communication barriers or unnecessary confusions, effective utilization of resources to achieve the quality and benchmarks, takes complete control of quality, cost and time and also enables prioritization and focus.

CHALLENGES IN QUALITY GATE

Some of the major challenges include increased paper work, extra work load for employees to revise or review all the documents and process before passing on to next step, additional time for the employees to learn a new strategic tool and proceed through lengthy quality criteria.

APPLICATION OF QUALITY GATE

The following table 1 shows some of areas where QG were implemented.

Table 1: Application of Quality Gate

IT Industry	IT Projects (Charvat, 2003) Software Development (Ambartsoumian, Dhaliwal, Lee, Meservy, & Zhang, 2011) & (Youn, 2011)
Construction Firms	Architecture, Engineering, Constructions and Facility Management (Froese, 2010)
Industry with more partnering and alliances	[Cooper, 2006]

CONCLUSION

Quality is the satisfactory index for a product to the customers. The control of inter dependable factors of cost, quality and time are carried out by various quality management techniques, such as six sigma, kaizen, statistical process control, quality assurance, process capability index etc. These quality tools help to prevent defects and to increase quality at the end of the production process, which includes the cost of rework, rejection, manpower and time. As such QG would bring down the time of searching the project back records, easy to identify the problem at early stage, reduces the cost of rework, increase the accuracy and effective projects to their clients. Moreover it gives a standardized format to carry out a project to define specific standard requirements. By computerizing the QG process would reduce the usage of paperwork and record keeping and floor space. While computerizing QG, and inter-relate with the scheduling software package would give the better outcome.

BIBLIOGRAPHY

1. 12Manage. (2007). *Manageing product development:explanation of the stage-gate model of Robert G. Cooper ('88)*. Retrieved January 14, 2013, from 12Manage: www.12manage.com/ methods_ cooper_stage-gate.html
2. Aaron, J. M., Bratta, C. P., & D, P. (1993). *Achieving total project quality control using the QG method.* Milestone Planning & Research, Inc.
3. Ambartsoumian, V., Dhaliwal, J., Lee, E. "., Meservy, T., & Zhang, C. (2011). Implementing Quality Gates Throughout The Enterprise IT Production Process. *Journal Of Information Technology Management, Xxii*(1), 28-38.
4. Ayas, K. (1997). Integrating corporate learning with project management. *International Journal of Production Economics, 51*, 59-67.
5. Bachy, G., & Hameri, A.-P. (1997). What to be implemented at the early stage of a large-scale project. *International Journal of Project Management, 15*(4), 211-218.
6. Barringer, B. B., & Gresock, A. R. (2008). Formalizing the front-end of the entrepreneurial process using the stage-gate model as a guide An opportunity to improve entrepreneurship

education and practice. *Journal of Small Business and Enterprise Development, 15*(2), 289-303.

7. Chao, L. P., & Ishii, K. (2004). Project quality function Deployment. *International Journal of Quality & Reliability Management, 21*(9), 938-958.
8. Charvat, J. P. (2003, January 31). *How to use quality gates to guide IT projects*. Retrieved April 27, 2012, from TechRepublic: http://www.techrepublic.com/article/how-to-use-quality-gates-to-guide-it-projects/1061893?tag=content;siu-container.
9. Chen, C.-H., Ling, S. F., & Chen, W. (2003). Project scheduling for collaborative product development using DSM. *International Journal of Project Management, 21*, 291–299.
10. Cooper, R. (1986). Winning at New Products. *Addison-Wesley, Reading MA*.
11. Cooper, R. (1994). Third-generation new product processes. *Journal of Product Innovation Management, 11*, 3-14.
12. Edwards, D. W. (1986). *Out of Crisis.* MIT. Cambridge, MA: Centre for Advanced Engineering Study.
13. Froese, T. M. (2010). The impact of emerging information technology on project management for construction. *Automation in Construction, 19*, 531–538.
14. Giebel, M., Esmann, H., Preez, N. D., & Jochem, R. (2008). Improved innovation through the integration of quality gates into the Enterprise and product Lifecycle Roadmaps. *CIRP Design Conference.* CIRP.
15. Juran, J., & Gryna, J. M. (1980). *Quality Planning and Analysis.* New York: McGraw-Hill, Inc.
16. *PROsys.* (1998). Retrieved from Quality Gates Methodology A Requirements-based Technique for Managing Quality: http://www.prosys-llc.com/Publications.htm
17. *Stage-Gate - Your Roadmap for New Product Development* . (n.d.). Retrieved December 16, 2012, from Product Development Institute Inc.: http://www.prod-dev.com/stage-gate.php
18. Youn, R. (2011). *Quality Gates in Solutions Projects: All They're Made Out to Be.* RCG Global Services.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

CHALLENGES FOR KNOWLEDGE TRANSFER IN VIRTUAL NPD - CASE STUDY

Päivi Lohikoski, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610, FI-90014, Finland
E-mail: Paivi.Lohikoski@Oulu.fi

Anyanitha Distanont, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610, FI-90014, Finland
E-mail: Anyanitha.Distanont@Oulu.fi

Harri Haapasalo, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610, FI-90014, Finland
E-mail: Harri.Haapasalo@Oulu.fi

ABSTRACT

Purpose: *Virtual product development teams are geographically dispersed and cross-functional, but yet they work on highly interdependent tasks by communicating electronically in work groups. This among other issues presents new challenges for the management of knowledge transfer. Based on literature, communication methods and practices that are widely used in ordinary work settings are not effective in virtual settings. New competencies and management procedures are needed. The present project uses qualitative methods to study what are the most significant challenges that affect knowledge transfer in virtual work settings in NPD. It is essential for the firms to "know what they know" and use that knowledge effectively, the size and geographic dispersion make it especially difficult to locate existing knowledge and use it where it's needed. This is why new information on knowledge transfer is needed.*
Methodology: *Qualitative case study that studies and describes the complex issue of managing virtual NPD.*
Findings: *This study provides information about major challenges for knowledge transfer in virtual NPD.*
Theoretical background: *Knowledge Management, Communications and Work- and Organizational Psychology.*
Originality/value: *This study discusses about the ways of leading experts and knowledge transfer in virtual NPD.*

Key words: Virtual Organization; Virtual Knowledge Transfer; Knowledge Management; Virtual Competencies

INTRODUCTION

Within few years more than 1,3 billion people will work in virtual organizations, therefore it is important to understand this development and these work environments characteristics better. (Johns and Gratton, 2013). There are a lot of mixed results whether technology effects and how does it effect on knowledge sharing, therefore more knowledge on virtual collaboration is needed. (Li, 2010; Faraj *et al.,* 2011.) In the world where everything is connected, and changing, the ability to adapt, learn and the ability to renew have become the most important factors of each organization and individual. (Lohikoski, 2011.) Research should therefore focus on understanding how virtual organizations respond to the tensions that arises in constantly and rapidly changing environments.

Success of knowledge workers is crucial to the performance of knowledge-based organizations, which form the basis of our global economy, therefore this study is very significant. There is a need for qualitative studies on this topical area in order to enhance the quality of knowledge management (KM) also in a case company. The above discussion can be condensed into the following research questions:

1. How is knowledge transfer in virtual NPD identified in the literature?
2. What are the major challenges in virtual knowledge transfer in the case project?

Case study organization is a leading global enabler of telecommunications services. With its focus on innovation and sustainability, the company provides a complete portfolio of mobile, fixed and converged network technology, as well as professional services including consultancy and systems integration, deployment, maintenance and managed services. It is one of the largest telecommunications hardware, software and professional services companies in the world.

RESEARCH PROCESS AND METHODS

Research process was started by an extensive literature review in virtual organizations, including cultural issues, communications, virtual work environment´s structure and knowledge transfer theories. Theoretical foundations lie mostly on knowledge management, work- and organizational psychology and human resources management.

Literature review was synthetized on chapter 3.5 and on a table “Characteristics of Virtual NPD according to the literature.” Theoretical basis was outlined and research questions formed for the semi-structured interviews in a case company. Actual study was conducted by qualitative semi-structured interviews, which builds on openness of unexpected. Semi-structured interviews make it possible to find new things and to keep a flexible design that can bring out the nuances and the meanings in a complex, tacit process of managing experts. Managing experts in virtual work environment especially is an area where new information is needed. To ensure exploration, qualitative method is the most appropriate method for conducting a study. (Marshall and Rossman, 1999). Figure 1 represents the research process.

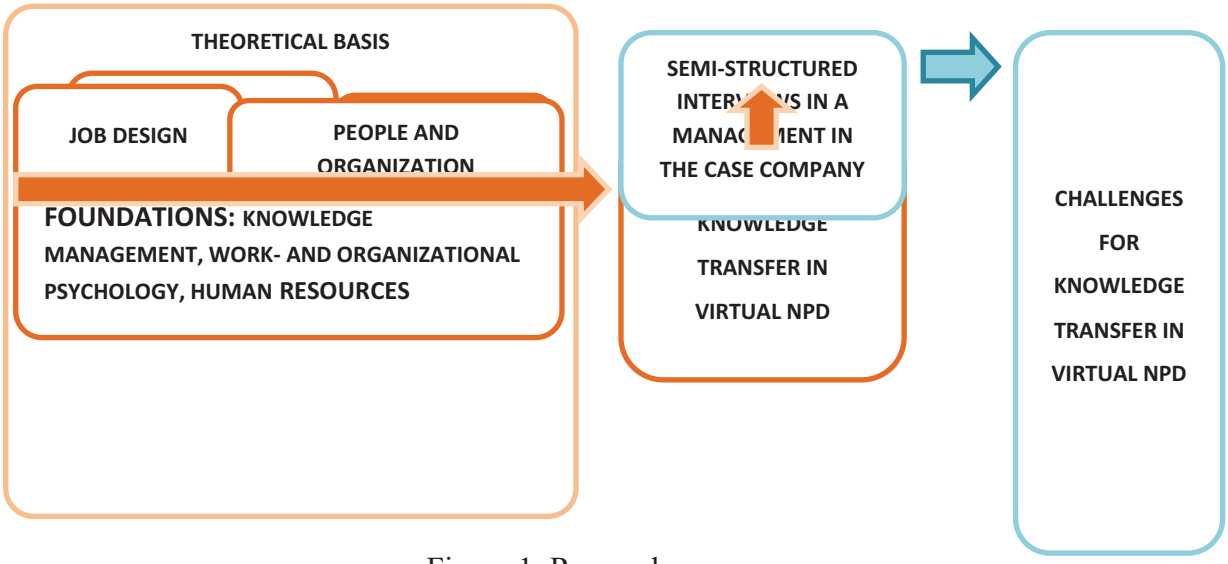


Figure 1. Research process

Study focused on level four managers within a case company. Managers´ work positions are e.g. Head of Product management or Head of Radio Platform Programs. Five of the manager´s position is in R&D, two were in Product Management and one manager´s position is in sales organization. All of their teams are globally dispersed including virtual communication on daily basis in various different locations. These managers had work experience of 14-28y and their work experience in virtual projects was between 10-20 years. According to the results there was a lot of diversity what comes to rating the challenges and in other issues concerning effective knowledge transfer in virtual organization.

VIRTUAL NEW PRODUCT DEVELOPMENT (NPD)

Virtual product development teams are geographically dispersed and cross-functional, but yet they work on highly interdependent tasks. This among other issues presents new challenges for the management of both explicit and tacit knowledge transfer. (Zigurs, 2003.) Global virtual teams are generally matrix-managed, culturally diverse and communicating mainly by using ICT. These virtual teams change form and dissolve rapidly due to rapid changes in a market. These team members also work for several different projects with competing priorities, therefore there are many risks involved when it comes to project deliveries on time. (Daim *et al*., 2012.)

Competition at the market has increased enormously and Cooper (2001) suggests following ingredients for the success: new technologies, intelligence, mobility and speed. Business environment is changing rapidly, which means opportunities can´t be missed. Pace of new product innovation has sped up and it has become increasingly important to leverage existing in-house competencies, resources and capabilities into new product projects. In global companies the only way to establish these kinds of teams rapidly is to form a virtual product development team. Modern technology can integrate mechanisms and systems and in this way provide a suitable platform for sharing internal and external resources. (Riege, 2005).

1. Knowledge and knowledge transfer

Communication and knowledge transfer are very closely linked together, effective communication enhances knowledge transfer and vice versa. Effective knowledge transfer can be achieved by integrating project requirements over organization boundaries. This can be done by providing guidance and standardized way of transferring knowledge, linking transferring processes together, creating a database for managing requirements and of course using the right transfer method for each purpose. (Distanont *et al*., 2012). There are many types of knowledge in literature, but in this study focus is on explicit and tacit knowledge. Explicit knowledge is formal knowledge that is easy to transmit between groups and individuals as Nonaka and Takeuchi (1995) has studied. Explicit knowledge is usually represented in a form of specifications, codes, numbers or different kinds of formulas. Explicit knowledge comes from tacit knowledge and this conversion of knowledge needs special attention especially in product development. Explicit knowledge can be seen as a source of competitive advantage.

However, tacit knowledge is personal knowledge, insights, know-how and deep understanding of contexts and it is usually hard to communicate formally to others. It develops in extended periods of time and therefore is highly personal and unique. Thus it is needed within organization to convert tacit into explicit knowledge and therefore secure competitive advantage in innovation and new product development. (Nonaka and Takeuchi, 1995.) Tacit knowledge is implicit used by organization members at their work and at making interpretations on their world in general. It is hard to pronounce, because it can mainly be used in action when doing tasks at work. Only human beings led by tacit knowledge have the capability to generate new knowledge. (Choo, 1998). Brown and Gray (1995) here: Choo (1998), adds that tacit knowledge means intuition, judgement and common sense – capacity to accomplish tasks without questioning everything. With groups, tacit knowledge can exist in relationships and distinct practices and social networks that emerge over time. It has been studied that sharing and finding relevant information becomes very difficult if the number of members exceed two hundred or three hundred. Stock of all the knowledge in an international company´s is scattered in offices and plants, complex mix of products and services is vast. It becomes very challenging for the expert to find what he needs. In summary: Knowledge is valuable only if it is accessible. (Davenport and Prusak, 2005.)

2. Tools for knowledge transfer

Johns and Gratton (2013) present that there are several platforms, where it is possible to have the company of other professionals. Company´s responsibility is to offer technologies that support higher achievement. Malhotra *et al.* (2007) outline that there are several ways when sharing knowledge virtually. Most companies have different kinds of cloud services, a virtual database, which can be far more than just a storage place for documents. Virtual living team rooms (Ms. LotusNotes) might be used in sharing knowledge, there are also company specific virtual meeting tools that can be used. However it is crucial that there are common rules about versioning the documents, about sharing and not sharing materials and about when to comment and communicate on team´s work.

Structure of meetings and virtual projects knowledge sharing is very important in virtual organizations. Organizations have discovered that the closer the work technology is to one´s own personal use of devices the faster new technology is adopted. (Johns and Gratton, 2013.) Virtual organization member´s patterns of communication: "when, why, how, how often and with whom they communicate?" can reveal a lot organization´s communication practices. These micro-interactions shape dynamic negotiation of member´s multiple interests and expectations. (Im *et al.*, 2005.)

3. Communication and virtual competencies

Many uses of technological resources are socially constructed between customers, internal and external functions. Considering this, technological change makes virtual organization´s operating environment very complex system where everyone is influenced by others. (Foss and Robertson, 2000). All the communication processes are influenced by people´s routines, which don´t operate in isolation. Organizational virtual capability is something which relates to integration and joint operation of routines. In this way organization is an effective operator that transforms the employee into the collective and makes it possible to generate more knowledge and skill and in this way give an unique character to the organization and to an individual. (Metcalfe and James, 2000). Badrinarayanan and Arnett (2008) go beyond that stating that team members of successful virtual NPDs develop superior decision making skills, perform future activities more efficiently and in addition to that, become more competent in acquiring, disseminating and processing information.
Anantatmula and Kanungo (2010) stresses the point that virtual teams and organizations need highly skilled individuals that need to participate extensively in conversations (good communication skills), having trustworthy behaviour (credibility) and having collectivist value (culture). According to Wang and Haggerty (2009) there are four factors that effect on individual virtual competencies:

- Early face to face meetings and training can help overcome the problems in technology
- Increasing technology skills and general familiarity with lean media.
- Assimilating other employee´s backgrounds
- Creating interpersonal relations with team members.

Research suggests that virtual team members cannot rely on simply transferring their behavior in traditional teams and expect to be successful in virtual environments. Explicit training in communication practices across different cultures and what constituted a timely response between the international teams are essential in making that virtual team a success. (Zigurs, 2003.) Success in current work environment and in a future requires employers that support and encourage employees work preferences. Employers also need to customize work environment so that it motivates and engages different personalities working together. (Johns and Gratton, 2013.)

Goodwill is hard to observe virtually, expectations about actions and the actions themselves need to be made as explicit as possible. Common set of procedures and communication norms are needed to prevent misunderstandings. Absence of communication norms lead members communicating his/her own ways, which doesn´t necessarily mean good knowledge sharing practices and distrust starts to develop. (Malhotra et al., 2007).

4. Virtual team´s job design

In virtual organizations structure is a fluid object, which is more like a dynamic space than a typical organization structure. In virtual organizations boundaries, norms, participants, artifacts, interactions continually change all the time. All organizations change, but these kinds of organizations change all the time. (Faraj et al., 2011.) Job design has been frequently researched in HRM sciences and it has been important variable for organizations that benefit from employees´ sharing knowledge. It is a crucial part of organization structure and it basically means the following things: identifying the relevant tasks and activities and allocating them across employees in a way that allows expert´s specialization fully to benefit organization. (Foss et al., 2009.)

There is a causal chain leading from certain kind of job design leading to particular job characteristics that have an impact on employees´ motivation to share knowledge. That all effects knowledge sharing behaviors of employees´. Organizational and group knowledge sharing are usually based on individual behaviors and their drivers. (Parker and Wall 1998, here: Foss *et al.* 2009) According to Riege (2005), in order to achieve continuous growth in business, knowledge-sharing practices need to become a day-to-day procedure. Successful sharing and goals depend on the three main factors: motivation, organization structure and modern technology. Flat and open structures make transparent knowledge flows possible and that provides culture of learning. Also strategy and goals are easier to link to people´s daily lives and in this way provide clear directions and feedback processes.

5. Cultural issues and collaboration

Schein (1996) presents that culture is a set of basic tacit assumptions about how the world is and ought to be. Culture is a group of people that share and determines their perceptions, thoughts, feelings, and, to some degree, their overt behavior. Cultures arise within organizations based on their own histories and experiences. It manifests itself at three levels: the level of deep tacit assumptions that are the essence of the culture. Also the level of espoused values reflecting group´s wishes to be ideally and what it wants to be publicly. Finally there is the day-to-day behavior that represents a complex compromise among the espoused values, the deeper assumptions, and the immediate requirements of the situation.

Any strategic plan must begin with clear goals, but especially in virtual organizations it´s crucial to focus more on collaboration, because it is the foundation of innovating faster and better. This kind of a purpose in mind right decisions can be made and leadership becomes more effective. (Johns and Gratton, 2013). Also Distanont et al. (2012) offer solutions to better human related knowledge transfer in collaboration. First it is important to organize face-to-face communication, especially at the beginning of the project. It also crucial to improve stakeholders´ skills, enhance social relationships between team members and assign right people to the right project. Knowledge sharing depends on the quality of informal and formal conversations between employees, and it is the organizational culture that decides how and with whom these conversations take place. (Paghaleh et al., 2011).

According to Kankanhalli et al., (2007) special characteristics of virtual work need to be identified and made known to team members through training to avoid conflict and to secure effective work along the project. Where possible cultural diversity could be minimized by

through appropriate selection of virtual team members, also in high-complexity tasks functional diversity can be enhanced to promote discussion about work tasks. Tasks conflicts need to be resolved integratively or distributively in order to improve performance. Giving feedback and quick response to the work well done is crucially important in virtual work environment. Possible conflicts in virtual teams are broadly categorized into two main types: relationship and task-based conflicts. Relationship based conflicts involves issues like mutual dislike, personality clashes and general annoyance of among team members. Some conflicts can be severe for team´s performance, but other´s can actually help team to perform better. Especially task-related conflicts seem to be more common and more severe in virtual organizations than in traditional teams. Task-related conflicts are usually based on functional differences caused by different backgrounds, assumptions and understanding based on their previous training and experience. (Kankanhalli et al., 2007.)

ISSUES EFFECTING KNOWLEDGE TRANSFER IN VIRTUAL ORGANIZATIONS BASED ON LITERATURE

Table 1, 2, 3 and 4 summarizes the main characteristics of knowledge transfer in virtual organizations latest research by using Distanont et al´s, (2013) solutions to overcome challenges in knowledge transfer. These classifications of this theory are based on division of Management, Working Process, Communication and Transfer Process as figure 2 represents:

Figure 2. Overcoming challenges in knowledge transfer. (Distanont et al., 2013).

Table 1. The main characteristics of knowledge transfer in virtual organizations in Management

Establish and maintain trust Special attention for mechanisms and communication processes in establishing trust is needed. Cognitive-based trust is the most relevant type of trust in virtual context.	Bergiel *et.al*, 2008; Malhotra *et al*.,, 2007; Denni *et a*l., 2013; Anantatmula & Kanungo, 2010; Holste and Fields, 2012; Atkinson and Butcher, 2012; Mitchells and Zigurs, 2009; Maude, 2011; Peters and Mantz, 2007; Han and Harms, 2010; Holton, 2001;
Conflict resolution strategies Potential issues causing conflicts should be acknowledged and strategies for proper conflict resolution methods should be planned beforehand.	Bergiel et. al, 2008; Zigurs, 2003, Maude, 2011; Kankanhalli *et al*.,, 2007; Holton, 2013;
Strong leadership Leader´s presence, support, control and motivation skills are needed in virtual collaboration. Shared goals, clear communication and competence in managing experts is needed.	Bergiel *et al.* 2008; Faraj *et al.,* 2011; Malhotra et. al, 2007; Dennis et.al., 2013; Snowden and Boone, 2007; Zigurs, 2003, Luther and Bruckman, 2011; Merat and Bo, 2013; Ivan *et.al.,* 2012; Cooper *et.al*., 2004, Goh, 2002;
Rewarding and feedback Rewarding and feedback processes need to be planned and established to support virtual collaboration and goals.	Malhotra *et.al*., 2007; Dennis *et.al*., 2013; Snowden & Boone, 2007; Zigurs 2003, Lam & Lambermont-Ford , 2010; Kankanhalli *et.al*, 2007; Cooper *et. al.,* 2004; Goh,2002;
Job satisfaction Virtual environment can cause feeling of isolation and lack of social contact, also multitasking and fluid working roles can in some cases decrease satisfaction at work.	Dennis *et al*., 2013; Kankanhalli *et al.*, 2007;
Less hierarchy and social conventions In virtual organizations structure is a fluid object and interaction is easier and less formal in virtual context.	Faraj *et al*., 2011; Lam and Lambermont-Ford , 2010;
Recruitment of talented employees Virtual environment enables recruitment of talented employees without changing geographical location. Moving away from home country isn´t necessary.	Bergiel *et. al* 2008; Holton, 2001; Faraj *et al.,* 2011; Ivan *et al.,* 2012;

Table 2. The main characteristics of knowledge transfer in virtual organizations in Communication

Virtual communication Effectiveness in task related communication is stronger in virtual environment. Dislike isn´t revealed in virtual discussion and cultural differences aren´t so significant.	Gressgård, 2011; Hardwick *et.al*, 2013; Wang and Haggerty, 2009; Badrinarayanan and Arnett, 2008;
Communication skills Verbal, written, oral, cultural knowledge and language skills are needed in order to ensure efficient communication between parties. Goal is usually to generate action, change or create common understanding.	Bergiel et.al, 2008; Holton, 2013; Faraj *et al*., 2011; Malhotra *et al,* 2007; Dennis *et al.,* 2013; Snowden and Boone, 2007; Maude, 2011; Luther and Bruckman, 2011; Cooper *et al*., 2004;
Members are knowledge transfer agents Networking virtual organization is possible across time, location and organizational boundaries.	Wang and Haggerty, 2009; Johns and Gratton, 2013; Zheng *et al*., 2011; Hardwick *et al*., 2013; Ivan *et al.,* 2012;

Table 3. The main characteristics of knowledge transfer in virtual organizations in Transfer process

Technology Modern technology can integrate mechanisms and systems and in this way provide a suitable platform for sharing internal and external resources. Technological failures can risk project deliveries on time.	Gatlin-Watts *et al.,* 2007; Badrinarayanan and Arnett, 2008; Cooper, 2001; Goh, 2002;
Multiple time zones & geographical dispersion Multiple time zones can be a challenge in a global multicultural company, when there is a need for shared meetings.	Bergie *et. al*, 2008, Badrinarayanan and Arnett, 2008; Faraj *et a*l., 2011; Dennis *et al*., 2013; Zigurs 2003; Li, 2010; Kankanhalli *et al.,* 2007;
Virtual competencies Virtual social skills, virtual media skills, Ict - skills and virtual self efficacy.	Wang and Haggerty, 2009; Faraj *et al,* 2011; Dennis *et al*., 2013; Luther and Bruckman, 2011; Foss & Robertson, 2000; Kankanhalli *et al*., 2007; Zigurs 2003,

Table 4. The main characteristics of knowledge transfer in virtual organizations in in working process

Training for virtual work is needed Characteristics of virtual collaboration should be acknowledged and training provided to enhance communication among team members. The sense of "we" rather than sense of "I" needs attention.	Zigurs, 2003; Kankanhalli *et al*, 2007; Han and Harms, 2010;
Relationship building and teaming Relationships and roles between team members need to be planned, identified and evaluated.	Gatlin-Watts *et al*., 2007; Holton, 2013; Wang and Haggerty, 2009; Faraj *et al*, 2011; Malhotra *et al*., 2007; Dennis *et al*., 2013; Snowden & Boone, 2007; Senge *et al*. 2007; Zigurs 2003; Kankanhalli *et al*., 2007; Greer, 2008; Goh,2002:
Passion, creativity and originality of multicultural team members Cultural and personality issues need to be considered and planned when forming teams, sharing tasks, communicating and giving feedback.	Bergiel et. al, 2008; Johns & Gratton, 2013; Holton, 2001; Badrinarayanan & Arnett, 2008.; Gressgård, 2011; Gatlin-Watts et al., 2007; Faraj *et al*., 2011; Luther and Bruckman, 2011; Dennis *et al.,* 2013; Li, 2010; Snowden and Boone, 2007; Maude, 2011; Kankanhalli *et al*., 2007; Gressgård, 2011;
Effective new product development New product innovation has become increasingly important and rapid in its nature. In-house competencies, resources and capabilities need to be leveraged into new product projects. In global companies this is done by modern communication technology in virtual product development teams.	Badrinarayanan and Arnett, 2008.; Gressgård, 2011; Luther and Bruckman, 2011; Kankanhalli *et al*., 2007; Cooper *et al*. , 2004;
Temporary convergence Human and Ict -related delays need to be planned and taken into consideration when planning a virtual project.	Faraj *et al*., 2011; Li, 2010; Zigurs 2003,
Tacit knowledge transfer Face to face meetings are needed and knowledge transfer in virtual collaboration needs extra attention.	Holton, 2013; Wang and Haggerty, 2008; Dennis *et al.,* 2013; Zigurs 2003, Distanont *et al.* 2012; Hardwick *et al*., 2013; Wang and Haggerty, 2009;

EMPIRICAL STUDY

Empirical study in a case company was conducted by semi-structured interviews in April 2013. Seven informants were chosen, based on their availability and ability to contribute the study from the management team of 20. Interviews took place in company ´s premises. Four of the informants´ positions within a company are e.g. Head of Program Management in R&D, two are Heads of Product Management and one informant´s title is Head of Sales. Informant´s ages were from 41 to 51 years. Two of the informant´s educational background

was M.Sc. Eng. and five were B.Sc. Eng. Informants had work experience from 18-28 years, from which 10-20 was in virtual organizations. Questions for the interviews were sent to informants beforehand. Each interview lasted from 35 up to 50 minutes and they were recorded and transcribed.
After the interview, informants were asked to rate the challenges in virtual knowledge transfer in a scale of 1-5 (1= no challenge, 2= minor challenge, 3= average challenge, 4= significant challenge, 5= major challenge). Challenges were added, calculated and summaries were made from each topic. As a main finding you can see the great variety and relatively big differences in opinion within informants. Main findings of the challenges are represented in figure 3.

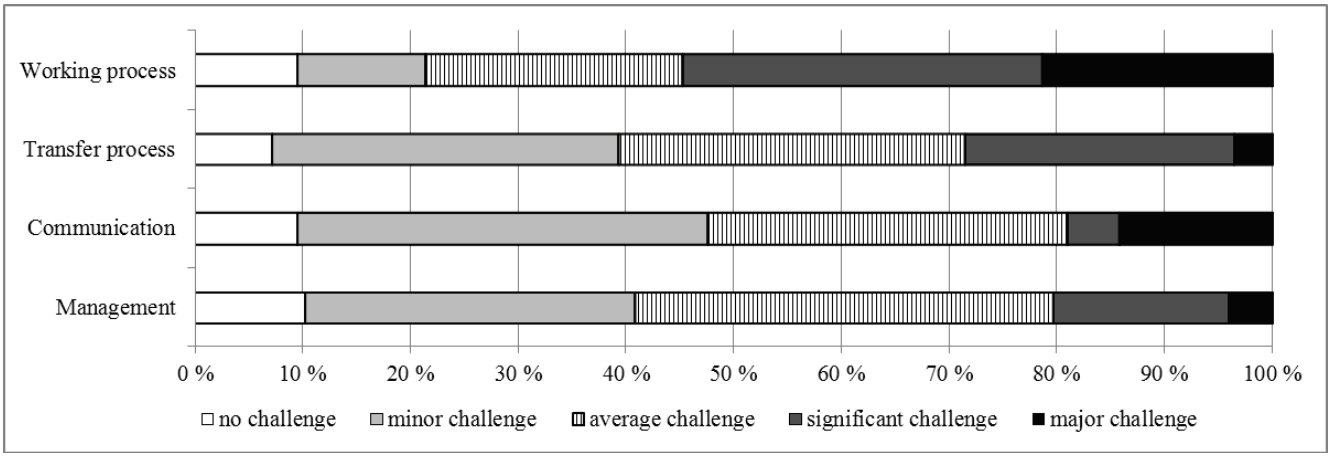


Figure 3 . Summary of challenges in knowledge transfer in virtual NPD.

1. Challenges in management

Trust has a very significant role in virtual NPD according to all informants. Trust develops in face to face communication according to over half of the informants. Some informants presented that trust can also develop also over time when communication is frequent and happens on regular basis. Above that informant C emphasizes the role of accurate information and expertise:

”It is definitely so that if you trust someone, you don´t have to double check the issues from other sources. If I tell something, then I know its valid, but if you receive information and you don´t know or trust the sender of a message, then you need to double check. In my experience… I´ve got a hunch when something isn´t right and whether that information can be used or not. So: Trust matters, and it only comes with time.”

Trust issues were rated everything from minor until major challenge. Informant E saw only minor challenges in trust, and what is standing out from informant E´s answers is that he relies strongly on fact -based communication and professional competence:

“If you trust someone, you tell more openly about things. All the facts will be discussed. There are all kinds of trust, but competence related trust is received by your own actions and by your performance at work. The fact that you have earlier taken care of things reliably and successfully is one thing. Well, that is The Most Important thing.”

Informants that saw trust as an average challenge, emphasized more formal documentation and structure of messages, or importance of phone calls instead of face to face conversations. Informant that saw trust as a major challenge emphasizes strongly face to face communication instead of just using fact based formal communication via ICT. Figure4 presents the challenges in management:

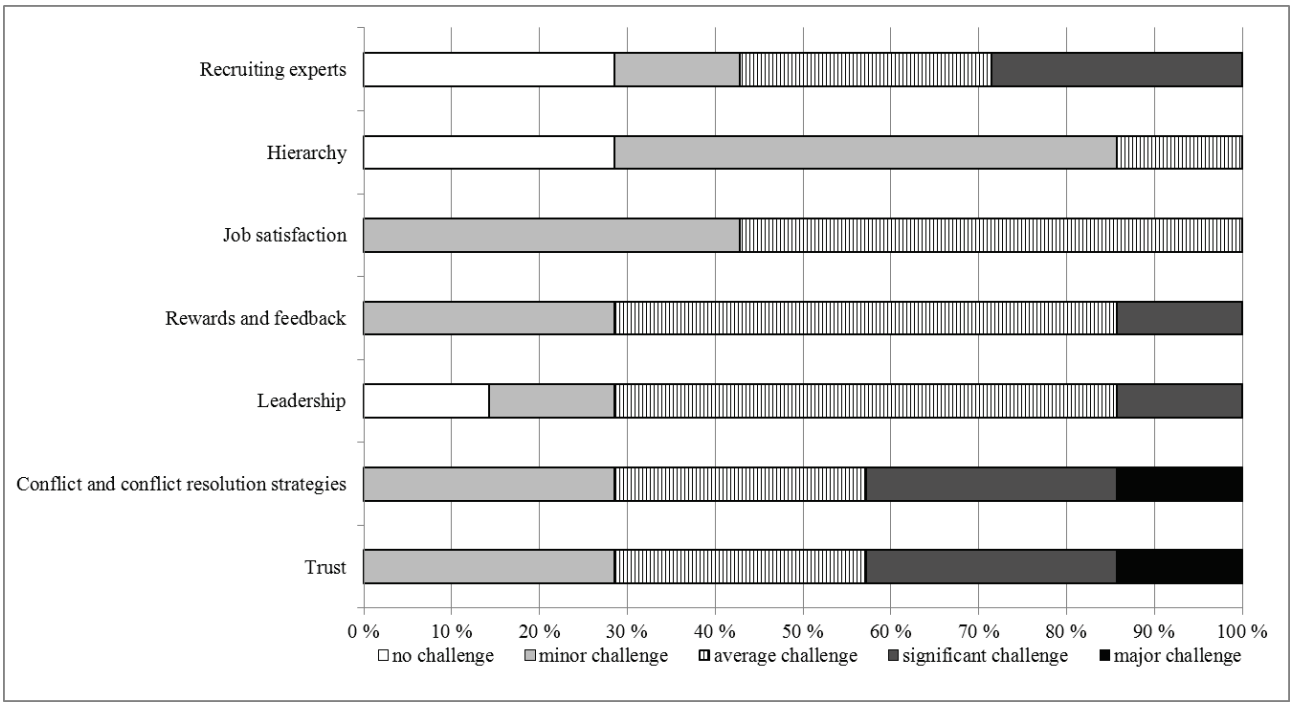


Figure 4. Challenges in management

Conflicts and conflict resolution strategies were marked mainly as average or significant challenge, but one informant considered conflicts are a major challenge and one informant as minor challenge. All informants mentioned competence related conflicts between sites the most common issue behind conflicts like informant G describes:

" I´d say conflicts are based on professional pride and identity. Sometimes there can be kind of a "invented here –attitude" that is basis for conflicts. You don´t want to transfer knowledge or something like that. It has something do with power, but I can´t understand or define that, because power is something you definitely don´t get with that kind of behavior. It is manager´s responsibility to solve those issues by building trust again."

Other issues causing conflicts were time differences, which make it difficult to find time for meetings together and also availability of relevant information becomes more difficult. What is interesting is that there aren´t conflict resolution strategies available and therefore managers are mainly the negotiators and mediators in solving conflicts. One informant mentioned co-operation teams and projects, which have been able to solve conflicts in the past. According to one informant, conflicts could be avoided by preventive actions e.g. proactive information sharing and by having shared discussions. Two informants mentioned importance of fact- based conversations in solving conflicts like informant E presents:

"Well, I start solving these issues fact-based, that what has gone wrong, what is the problem and start from there. We check the issue and see what is behind that conflict. Then all the people that are involved get together so that everyone has the same information, same knowledge and same right to give comments. So no mediators, we solve those conflicts together, only based on facts."

Generally leadership was seen as an average challenge, but what was interesting and very descriptive of this study as a whole, was the fact that there were altogether 24 different kinds of characteristics mentioned when informants were asked about qualities of a good virtual leader. Almost all informants said that most important skill is an ability to lead people, four mentioned that active and frequent communication is important, but after that was more variety. Informants mentioned skills and characteristics like written and oral communication skills, honesty and integrity, availability 24/7, professional competence, openness and prioritizing skills. Informants also mentioned e.g. strategy knowledge, trust, supportiveness and decision making skills and innovativeness and an ability to see the big picture.

These managers seem to do their work very personally with their own unique ways and experience. All the views in characteristics of a good manager mean that further studies on this topic are needed. Also availability 24/7 issue was mentioned by all informants at course of the interviews and it seems like some better knowledge on combining professional and personal life might be needed in order to enhance virtual leader´s job satisfaction and efficiency. Two informants said at the interview that they find it difficult to leave the office during the day 8-16, even if there was a chance to take care of some personal issues while working. Successful work in virtual organizations is hard to define, because it is hard to measure. In literature there are views that emphasize successful combination of work and home and views that are concentrated on performance metrics at work. (Muna and Zennie, 2010.) Further studies in successful combination of professional and personal life are also needed.

2. Challenges in communication

When informants were asked about the qualities of effective virtual communication, they mostly pressed the importance of taking the message receiver into account. Also planning the content and outlook of the message right was mentioned important. Decisions and information letters need to be written and sent ad hoc according to almost half of the informants. Only few mentioned the importance of clear and succinct e-mails, which is a significant part of virtual communication according to the theory. Also 12 other qualities of good communication were mentioned, which means there is a variety of different ways and variety of different kinds of practices when communicating virtually. Communication is a very crucial factor in manager´s work as informant B states. According to him, most delays in NPD are based on communication problems:

"Communications are the biggest, or communication problems are the biggest causes for failures, when failures appear in any project. If something is wrong somewhere, it is usually based on challenges in communication. Often about 80% of problems arise when people don´t know something or it has been a communication problem."

One informant had participated in virtual communication training and he had evaluated his own virtual communication competence more than others. Also training issue was seen as a bigger challenge with this informant, which might mean that he is aware of the issues concerning virtual collaboration and connection of virtual communication competencies. This same informant mentioned that lack of face to face communication is a minor challenge, where those that evaluated their own virtual communication competence weaker than others´ saw that lack of face to face communication is a significant or a major challenge. Communication training is also discussed in working processes. Figure 5 represents challenges in communication category:

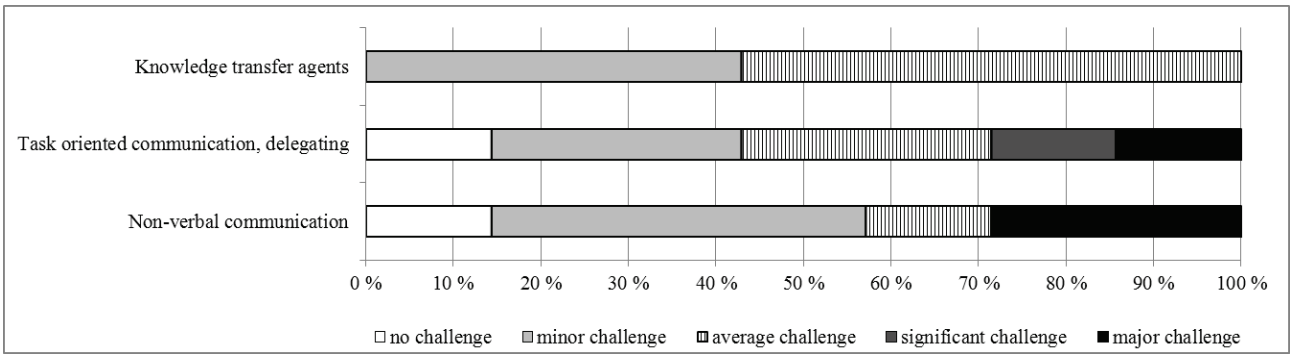


Figure 5. Challenges in communication

3. Challenges in transfer process

All informants stated at the interviews that there are problems in ICT they use, but when rating the challenges, there was a lot of variety. It is surprising that it seems like informants had accepted the unbalanced situation with task-technology-structure fit. There are tools for social interaction and networking, but they are not used according to these informants due to many of reasons, but most importantly lack of time. They also didn´t see those tools beneficial and useful to their work. There are also problems with availability and reliability of some virtual meeting tools.
In rating the challenges, ICT was marked as a significant challenge, as an average challenge and as a minor challenge, but some informants saw no challenges at all. In generally informants said in the interviews that there are too many tools and people don´t seem to know where to find relevant information like informant A describes:

“E-mail is the most common tool and it is ok. In meetings we use Webex, so we show slides, but it is unstable tool, but when it works it´s fine.. Then we have Team Site, Community Site, My Site etc.. but I don´t know about those.. You never know where anything is. They have brought in new tools and it has become a mess. I mean those tools work, but from the user perspective it takes too much time to think where and when is the data and communication of some project or a person. I mean idea is good, but implementation is undone. Kind of a culture that we start doing something and then we over do it. It is hard to find the “golden mean”.

Virtual communication competencies were an interesting issue. All informants gave higher ratings to challenges in virtual competencies to themselves than to others.

Time differences and geographical dispersion were also mentioned by all informants, however it was surprising that time differences weren´t any greater challenge. Three informants mentioned that it can even be a benefit e.g. in testing new products. When working day ends, it starts in another location and testing products can be made continuously and effectively in this way. Figure 6 summarizes the challenges in knowledge transfer process:

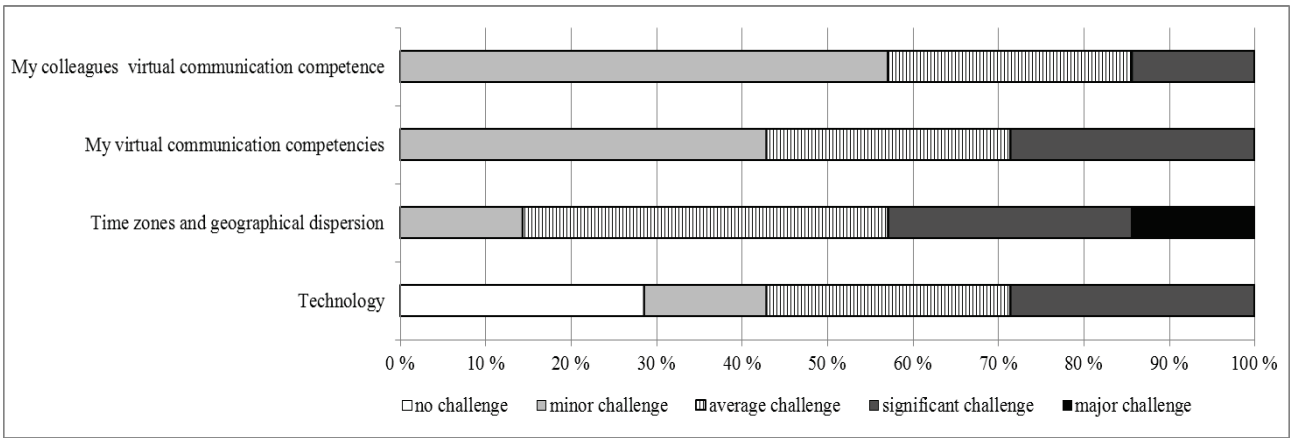


Figure 6. Challenges in knowledge transfer process

4. Greatest challenges are in working processes

From managers´ perspective the most challenges are found in issues concerning working processes. In working processes the relationships, tacit knowledge transfer, effective NPD, and temporary convergence were the most challenging issues as described in figure 7.

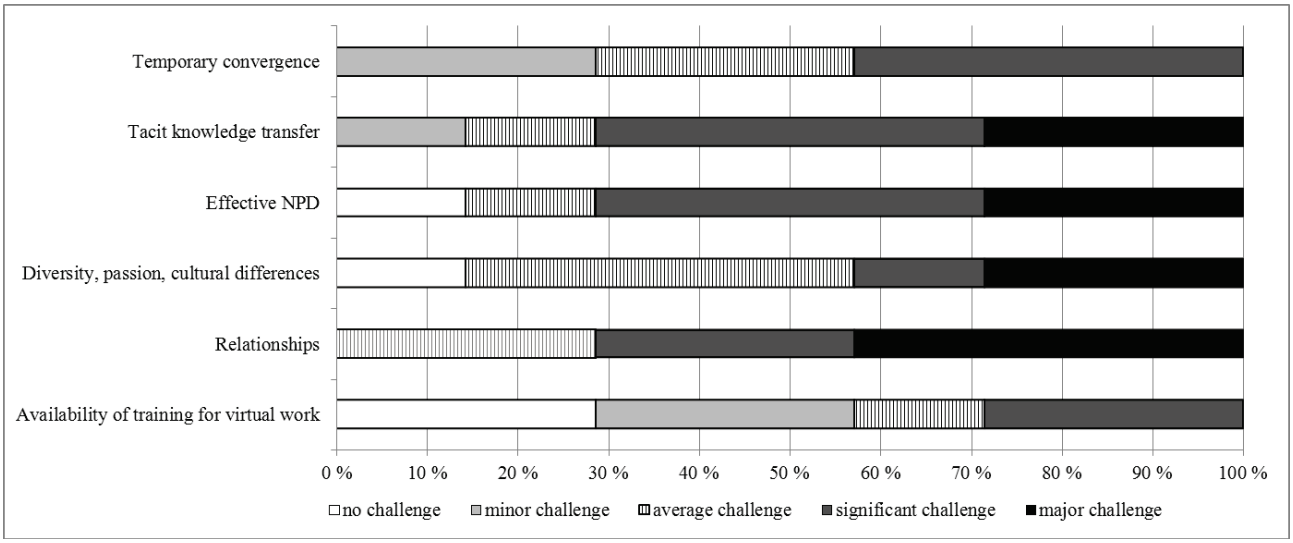


Figure 7. Challenges in working process

Greatest challenges in working processes were found in building and maintaining relationships within multicultural virtual environment, which was stated as a average, significant or major challenge by all except one informant, who stated that it isn´t a challenge

at all. All informants were familiar with cultural differences and all informants mentioned that they are considering cultural issues when sharing tasks and giving feedback. All informants had lived abroad and/ or participated cultural training. Informant F describes the importance of taking the message receiver´s background into consideration when sharing tasks, doing follow ups and giving feedback:

"Delays in a project happen because sometimes a person simply doesn´t know what to do, so communication hasn´t been good enough. So then we come to the issue, how important the successful virtual communication is. If you know who the person is, you know how to communicate the issue clearly, then you do the follow up to see that is it going anywhere and what direction is it going. Then depending on the culture, the feedback conversation is different with each individual. Other cultures can´t take feedback, but you just have to get the message through somehow. Those faults and failures need to be fixed."

In virtual projects in this field of business innovating fast is crucial. Therefore effective collaboration is needed and leading effective virtual teams is possible, if cultural issues are taken into consideration. (Johns and Gratton, 2013). Success in any collaboration between people and organizations is based on quality of relationships that shape cooperation, trust, mutuality and joint learning. It is important to have face-to-face meetings first, like informant C states:

"If we have met face to face, for some reason trust develops even after the first meeting and after that sharing knowledge is easier. If we haven´t met at all, there always is a risk that people stay in silos."

According to these managers everything can be handled virtually, except negative personal issues, redundancy notices and critical feedback meetings, but it was also stated by half of the managers, that if you have met face to face even once, everything can be handled virtually after that. What is interesting is that according to one informant, everything can be handled virtually. Face to face conversation isn´t necessarily needed at all.

Building relationships within teams, the practices varied even more. Most informants stated that quality and characteristics of team co-operation isn´t evaluated. Some informants said that in economically tough times there hasn´t been recreational team building events, however one manager mentioned that creative and strong team leaders can organize low budget team building events in any times. There were also other ways to enhance team´s performance e.g. horizontal interaction with cross-review, monthly information sharing meetings for formal and informal communication and voluntary informal communication. In summary, there aren´t official procedures in evaluating team building and performance, team building practices are based on each manager´s personal experience and preferences and evaluation is only done if team fails or performs exceptionally well.

Challenges in virtual NPD divided opinions: most informants stated that virtual organization structure makes NPD more difficult like informants E and B present**:**

"Of course we always hope that everything would be done in one site. It has been noted that it is the clearest and simplest way to do it. Then only support from other sites, but that isn´t always in balance with us. So I can say that NPD suffers a bit. There always is some kind of

tension when you don´t know the people. There are new people here and there..and when you don´t yet have experience in working with these people, it takes time, more time for these designers to build trust and to create and to prepare things, so there´ll always come surprises..."(E)

"Well, it does effect.. We haven´t been able to make it and in this moment we have projects that are just plain chaos and they´ve been divided into six, seven even eight different sites. So you can imagine what kind of challenges there are when it comes to sharing information, communicating, sharing work packages, negotiating and integrating… So in my opinion it is mission impossible and virtual Npd shouldn´t even exist." (B)

However some informants thought that virtual NPD is a strength and built-in this business, like informant G suggests:
" First of all, when it comes to developing complex products like this, there are only very few places in a world where you can find all the needed competencies within same walls, so basically we are forced to this kinds of geographical dispersiveness. Then the virtuality helps us to develop these kinds of products, we can make them together. So virtuality is built in and all the sites and teams and organizations compliment each other. For some reason, in a world... there are these kinds of knowledge centers..."

Availability and participation in communication training wasn´t seen challenging among the informants. Most informants had participated communication training a long time ago. Only few informants mentioned training portal, and only one named relevant virtual communication classes that are available. Almost all informants hadn´t participated virtual communication classes at all. One informant stated that he hadn´t participated any communication or virtual communication classes and he didn´t even know if there is such training available. Importance and meaning of virtual communication training clearly isn´t recognized.

In summary, there is a lot of variety in manager´s perspectives in a complex multicultural environment. Less than half of the informants thought that virtual NPD is strength, mainly because of a inbuilt wide social network and contact surface globally. Rest of the informants thought that innovativeness can decrease and time differencies can cause inefficiency and difficulties in decision making. Informants that saw virtual NPD beneficial, stated that it is possible when preparations for virtual meetings are made in advance and time differences are taken into consideration when making plans.

Virtual NPD work is sometimes done also at home, which means that combining work and home successfully is needed in virtual work. Successful virtual work is beneficial to the company, but it is also beneficial to the manager working in virtual projects. According to Badrinarayanan & Arnett (2008), team members of successful virtual NPDs develop superior decision making skills, perform future activities more efficiently and also become more competent in acquiring, disseminating and processing information.

CONCLUSIONS

Research suggests that virtual team members cannot rely on simply transferring their behavior in traditional teams and expecting it to be successful in virtual environments. (Zigurs, 2003.) New kind of communication competencies for virtual collaboration is needed. Communicating without proper training to virtual collaboration leads people into communicating with their own ways, and that can lead to development of distrust. (Malhotra et al., 2007.) Organizational knowledge sharing improves, if personal networks are respected and organizations take part in improving them. In such case also cross-cultural knowledge sharing can be improved. (Li, 2010.)

This research´s validity is in studying by qualitative methods the complex issue of knowledge transfer in virtual NPD. Informants had relatively long history in virtual organizations, which is important when collecting this kind of research data. In this study it was surprising, how much diversity there are within managers that operate in a same company. This research confirms the fact that traditional ways of communication might not work in best possible ways when leading experts in virtual organizations. Challenges and problems are recognized in human related issues, but the connection between virtual communication competencies and relationship building and tacit knowledge transfer hasn´t been recognized.

More information on virtual competencies in organizational and individual level is needed and on their meaning and role in efficient and successful knowledge transfer process. Also characteristics of leadership and role of trust on knowledge transfer should be studied further in virtual organizations. Limitations of this study include analysis of only one company. Further studies in characteristics of virtual competencies and virtual leadership are needed in order to enhance the quality of work and job satisfaction of employees in global virtual organizations.

REFERENCES

1. Anantatmula, V.S., Kanungo, S. (2010), ”Modeling enablers for succesful KM implementation”, Journal of Knowledge Management, Vol. 14 Iss. 1 pp. 100-113.
2. Atkinson, S. and Butcher, D. (2012), “Trust in Managerial Relationships”, Journal of Managerial Psychology, Vol. 18 Iss. 4 pp. 282-304.
3. Badrinarayanan, V. and Arnett, D.B. (2008), “Effective virtual new product development teams: an integrated framework” Journal of Business & Industrial Marketing, Vol. 23 Iss. 4 pp. 242-248.
4. Bergiel, B.J., Balsmeier, P.W., Bergiel, B., Erich B. (2013), “Nature of virtual teams: a summary of their advantages and disadvantages” Management Research News, Vol. 31 Iss. 2pp. 99-110.
5. Choo, C.W. (1998), The Knowing Organization- How organizations use information to construct meaning, create knowledge and make decisions. Oxford University Press, New York.
6. Cooper, R. G. (2001), Winning at New Products. Accelerating the Process from Idea to Launch. Perseus Publishing. Cambridge, Massachusetts.
7. Cooper, R.G., Edgett, J.S., and Kleinschmidt, J.E. (2004), “Benchmarking Best NPD Practises –I”. Research Technology Management, 47, 1, ABI/Inform Global, pp. 31-43.
8. Daim, T.U., Ha, A., Reutiman, S., Hughes, B., Pathak, U., Bynum, W., Bhatla, A.

(2012), "Exploring the communication breakdown in global virtual teams" International Journal of Project Management, 30, 199, 212 pp. 1-14.
9. Davenport, T.H. and Prusak, L. (2005), "Working Knowledge: How Organizations Manage What They Know". Ubiquity An ACM IT Magazine and Forum. Vol.11.2. pp. 1-15.
10. Dennis, D.J., Meola, D., Hall, MJ. (2013), "Effective Leadership in a Virtual Workforce". T&D,Vol.02, pp. 47-51.
11. Distanont, A., Haapasalo, H. and Vaananen, M. (2012 Accepted), "Organising knowledge transfer in requirements engineering over organisational interfaces", International Journal of Innovation and Learning.
12. Faraj, S., Jarvenpaa, S.L., and Majchrzak, A. (2011), "Knowledge Collaboration in Online Communities", Organization Science, Vol. 22 No. 5 pp.1124-1239.
13. Foss J. et al. (2009), "Encouraging Knowledge Sharing Among Employees: How Job Design Matters" Human Resource Management, Wiley Periodicals, Inc. Nov-Dec, Vol. 48, No.6, pp. 871-893.
14. Foss, N.J. and Robertson, P.L. (2000), "Resources, Technology and Strategy .Explorations in the resource-based perspective", Routledge: London.
15. Gatlin-Watts, R., Carson, M., Horton, J., Maxwell, L., Maltby, N. (2007), "A guide to global virtual teaming", Team Performance Management. Vol. 13 No. ½. pp. 47-52.
16. Goh, S.C. (2002), "Managing effective knowledge transfer: an integrative framework and some practice implications", Journal of Knowledge Management, Vol. 6 Iss: pp. 23-30.
17. Greer, S. (2008), "A Lessons-Learned Knowledge Management System for Engineers.-An organizational lessons-learned system facilitates the transfer of knowledge from one project team to another", Chemical Engineering; Aug, 2008; 115; 8. pp. 50-52.
18. Gressgård, L.J. (2011), "Virtual team collaboration and innovation in organizations", Team Performance Management, Vol. 17 Iss. 1 pp. 102-119.
19. Han, G.H. and Harms, P.D. (2013), "Team identification, trust and conflict: a mediation model", International Journal of Conflict Management, Vol. 21 Iss: 1 pp. 20-43.
20. Holste, S.J. and Fields, D. (2010). "Trust and tacit knowledge sharing and use", Journal of Knowledge Management, Vol. 14. 14 Iss: 1 pp.128-140.
21. Holton, J.A. (2001), "Building trust and collaboration in a virtual team", Team Performance Management: An International Journa, Vol.7. Iss: ¾ pp. 36-47.
22. Im, H-G, Yates, JoA and Orlikowski, W. (2005), "Temporal coordination through communication: using genres in a virtual start-up organization", Information Technology and People. Vol. 18 Iss. 2 pp. 89-119.
23. Ivan, I., Ciurea, C., Doinea, M.,(2012), "Collaborative Virtual Organizations in Knowledge-based Economy", Informatica Economicá, Vol. 16, No. 1 pp. 143-154.
24. Johns, T. and Gratton, L. (2013), "Spotlight On The Future Of Knowledge Work. The Third Wave Of Virtual Work", Harvard Business Review, Jan/Feb. pp.66-73.
25. Juntunen, R-L., Takala, M., Tamminen, P. and Vuori M. (2013), INSCO Innovation in sourcing competencies (Ed.) Research dissemination report. Aalto University: Helsinki.
26. Kankanhalli, A., Tan, B.C.Y., and Wei, K-K. (2007),"Conflict and Performance in Global Virtual Teams", Journal of Management Information Systems, Vol.23, No. 3, pp. 237-274.

27. Lam, A. and Lambermont-Ford, J-P., (2010), "Knowledge sharing in organizational contexts: a motivation-based perspective", Journal of Knowledge Management, Vol. 14 Iss. 1 pp. 51-66.
28. Li, W. (2010), "Virtual knowledge sharing in a cross-cultural context." Journal of Knowledge Management, Vol. 14 Iss. 1 pp. 38 – 50.
29. Lohikoski, P. (2011), "Renewal and personal mastery in knowledge-based organizations. The case of a Finnish ICT-company" Costa, G. (Ed.), Ethical Issues and Social Dilemmas in Knowledge Management: Organizational Innovation. IGI Global. pp. 160-179.
30. Luther, M. and Bruckman, A. (2011), "Leadership and Success Factors in Online Creative Collaboration", IEEE Potentials, 6. pp. 27-32.
31. Malhotra, A., Majchrzak, A., Benson, R. (2007), "Leading virtual teams", Academy of Management Perspectives. Vol. Feb, pp. 60-70.
32. Maude, B. (2011), Managing Cross-Cultural Communication. Principles and Practise, PalGrave MacMillan, London.
33. Marshall, C. and Rossman, G.B. (1999), "Designing Qualitative Research 3rd Edition". Sage Publications. (e-book)
34. Merat, A. and Bo, D. (2013), "Strategic Analysis of Knowledge Firms: the links between knowledge management and leadership", Journal of Knowledge Management. Vol. 17 Iss. 1 pp. 3-15.
35. Metcalfe, J.S. and James, A. (2000), "Knowledge and capabilities: A new view of the firm". In: Foss, N.J. & Robertson, P.L. "Resources, Technology and Strategy: Explorations in the Resource-Based Perspective". Routledge, London.
36. Mitchell, A. and Zigurs, I. (2009), "Trust in Virtual Teams: Solved or Still a Mystery?",
37. The Database for Advances in Information Systems, Vol. 40, No 3, Aug. pp. 61-83.
38. Muna, F.A. and Zennie, Z.A. (2010), Developing Multicultural Leaders, The Journey to Leadership Success, Palgrave MacMillan, Chippenham and Eastbourne.
39. Nonaka, I. and Takeuchi, N. (1995), The Knowledge Creating Company. Oxford, Oxford University Press.
40. Paghaheh, J.M., Shafiezadeh,E., and Mohammadi,M. (2011), "Information Technology and its Deficiencies in Sharing Organizational Knowledge" International Journal of Business and Social Science. Vol. 2 No. 8. pp. 192-198.
41. Peters, L.M. and Manz, C.C. (2007), "Identifying antecedents of virtual team collaboration", Team Performance Management, Vol. 13. Iss: 3 pp. 117-129.
42. Riege, A. (2005), "Three-dozen knowledge sharing barriers managers must consider." Journal of Knowledge Management, 9(1), 18-35.
43. Schein, E.H. (1996), "Three Cultures Management: The Key to Organizational Learning", Sloan Management Review, 38(1), Vol. 6 No. 5. pp. 2-24.
44. Senge, P.M., Lichtenstein, B.B. Kaeufer, K., Bradbury, H., Carroll, J.S. (2007), "Collaborating for Systemic Change", MIT Sloan Management Review, Vol. 48. No. 2. pp. 44-53.
45. Snowden, D.J. and Boone, M.E. (2007), "A Leader´s Framework for Decision Making", Harvard Business Review. Nov. pp. 1-9.
46. Wang, Y., and Haggerty, N. (2009), "Knowledge transfer in virtual settings: the role of individual virtual competency." Info Systems Journal, 19, pp. 571-593.
47. Zigurs, I. (2003), "Leadership in Virtual Teams: Oxymoron or Opportunity?" Organizational Dynamics, Vol. 31, No. 4, pp. 339-351.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

EARLY STAGES OF TECHNOLOGY-INTENSIVE COMPANIES IN SOUTHERN CALIFORNIA

Matti Muhos*, Oulu Southern Institute, University of Oulu, Finland
matti.muhos@oulu.fi,
***corresponding author**

Pekka Kess, Department of Industrial Engineering and Management, University of Oulu, Finland
pekka.kess@oulu.fi

Lada Rasochova, Rady School of Management, University of California San Diego, CA, USA
lrasochova@ucsd.edu

Del Foit, Rady School of Management, University of California San Diego, CA, USA
dfoit@ucsd.edu

ABSTRACT

Purpose: *Numerous stage models have attempted to clarify management priorities during the early stages of companies. However, a need for more focused and context-specific studies exists. This study seeks to clarify the early stages of technology- intensive companies in Southern California. To summarise the research questions, the authors ask: What early stages do technology-intensive companies face based on empirically based stage literature? How do the experiences of managers in early-stage technology-intensive companies relate to assumptions of such stage framework? What viewpoints should be considered when using stage framework in context of Southern California?*
Design/methodology/approach: *To answer these questions, this retrospective multiple case study devises a four-stage framework describing early stages of technology-intensive companies and reflects it through nine case studies. The study utilises sequential incident technique (SIT) and semi-structured interviews in data collection. Three perspectives were analysed in each case company for triangulation purposes – one from company management, one from operations management, and one from marketing management.*
Findings: *The applicability of the framework will be clarified in this study; moreover, an analysis of context-specific viewpoints will be provided. It is necessary to recognise these viewpoints when using this framework in Southern California.*
Research limitations/implications: *The research focus of this study is limited to the context studied. This limits the applicability of the explorative and descriptive results to other contexts.*
Practical implications: *The results of the study may be effectively used in intermediary organisations and companies as framework for predicting the early-stages of technology intensive companies.*
Originality/value: *The context specific viewpoints and their affect to the early stages of company have not been broadly studied - this study takes the context into account and provides new insights into growth-management of technology-intensive companies in the studied context.*

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

Category: Research paper
Keywords: stages of growth; growth process; Southern California; sequential incident technique; technology-intensive companies;

INTRODUCTION

Firm growth and development have been studied extensively in the last decades, and the literature in this area includes many perspectives, such as the static equilibrium theories (see e.g., Coase 1937), stochastic models (see e.g., Gibrat 1931), transaction cost theories (see e.g., Williamson 1975), economics of growth theories (see e.g., Penrose 1959), resource-based theories (see e.g., Penrose 1959)), evolutionary theories (see e.g., Nelson & Winter 1982), organisational ecology theories (see e.g., Hannan & Freeman 1977), strategic adaptation theories (see e.g., Sandberg & Hofer 1982), motivational theories (see e.g., McClelland 1961), and configuration theories (see e.g., Greiner 1972), among others. Most of the perspectives presented above are concerned with the factors leading to growth. However configurations (or company life-cycle or stages of growth) (see e.g., Muhos *et al.* 2010, Muhos 2011) perspective have instead attempted to clarify managerial challenges and priorities in the early stages of companies (see e.g., Churchill & Lewis 1983, Greiner 1972). This perspective relates to what growth brings to a company and how to manage a growing company (see Davidsson & Wiklund 2006, Wiklund 1998). Growth configuration literature reveals diverse managerial problem configurations specific to the different growth stages.

The main findings of the fourteen recent empirically based stage models focusing on technology-intensive companies have been synthesised to a self-evaluation framework (Muhos 2011). To test the findings, empirical cases in different cultural business contexts needs to be studied. Doing so will allow analysis of gaps between the reality and the stage models and will highlight potential paths for further development of these models. This study aims to describe the early development stages of technology-intensive companies in the Southern Californian business context.

The research problem is condensed into the following research questions: What do early-stage technology-intensive companies face based on recent empirical literature? How do the experiences of managers in early-stage technology-intensive companies relate to assumptions of such stage framework? What viewpoints should be considered when using stage framework in Southern Californian context?

This is a retrospective multiple case study with holistic research strategy – the study utilises Sequential Incident Technique (SIT), a specific form of Critical Incident Technique (CIT) (Edvardsson & Roos 2001, Fisher & Oulton 1999, Flanagan 1954).The following definitions figure prominently in this analysis. We define an early-stage technology-intensive firm in three parts: first, a technology intensive firm is an independently owned research- and product development-intensive company whose continuous aspiration to valuable, rare and inimitable knowledge in technology leads to new or enhanced products and services (see Salonen 1995, Tesfaye 1997). Second, the term early refers to the newness of the firm; according to Storey & Tether (1998) a new firm is not more than 25 years old. Third, the term stage corresponds to a unique configuration of variables, e.g., strategies, problems and priorities that growing firms will likely face (see e.g., Coad 2007, Hanks *et al.* 1991, Miller &

Friesen 1984). The term configuration applies to the clusters or frameworks of common variables used for analysis of stages.

This study addresses scholars interested in the process perspective on company growth and development. The study may also function as a useful guide for those responsible for company growth and development polices, those considering investing in a defined group of companies and the owners and managers of growing companies. In the theoretical part of this study the current state of configurations literature is presented. In the empirical part of the study the nine case companies from the Southern California are described and their experiences of growth reflected through stages framework to identify parallel and context specific viewpoints. Finally, this study analyses the applicability of the framework to the cases of Southern California and describes the context specific issues.

EARLY STAGES OF GROWTH – THE SELF EVALUATION FRAMEWORK

Table 1. Early stages of technology-intensive companies – assumptions of the self-evaluation framework

Stage	Stage description/assumption codes
1. Conception and development:	Newly established firm is owner-dependent (1-A1). The objective is product and/or technology development (1-A2) and establishment of an early customer base (1-A3). The main activities relate to the business idea (1-A4), identification of a market (1-A5) and resource mobilisation (1-A6). Development of a working prototype is started (1-A7). The management is informal, flexible and creative (1-A8); communication is face-to-face (1-A9), and the owner makes the decisions (1-A10). Organisation functions as a product-development team (1-A11). Cash flow falls into the red due to lack of product at this point (1-A12).
2. Commercialisation	Stage begins with the early-reference customers (2-A1). Objective is creation of a business and commercialisation of the product (2-A2). Stage is characterised by early manufacturing (2-A3), marketing (2-A4) and initial technical challenges (2-A5). Company learns to make the product and to produce it (2-A6). Management style is participative (2-A7) and coordinative (2-A8). Owner and/or small number of partners dominate the nucleus of the administrative system (2-A9). Resource generation and survival are key issues (2-A10). Amount of negative cash flow decreases (2-A11).
3. Expansion	At this stage, manufacturing and technical feasibility and market acceptance lead to high growth (3-A1) and constant change (3-A2). Main objective: manage the company toward growth and increase market share by marketing and manufacturing the product efficiently and in high volume (3-A3). Company needs to produce, sell and distribute the product at an increasing volume (3-A4) while taking care of efficiency and effectiveness through structures and processes (3-A5). New customers and new market channels require constant attention (3-A6). Personnel problems result from high growth (3-A7). Owner and/or entrepreneurial team are central,

Stage	Stage description/assumption codes
	though a sense of hierarchy increases (3-A8). Budgets are moderately used for communication (3-A9). More specialised functions considered and added (3-A10). Positive cash flow increases rapidly (3-A11).
4. Stability/renewal	Company faces a slowing growth rate (4-A1) and intense competition in maturing product market (4-A2). Effort needed to launch a second generation of the product and for effectiveness and efficiency issues (4-A3). Identification of new markets is essential for company renewal (4-A4). However, cost control and productivity become main concerns (4-A5). Resulting product generation and profitability improvements maintain growth and reasonable market share (4-A6). Owner usually supported by or replaced by a professional manager or a management team and professional management systems are added (4-A7). Strategies, rules, regulations and procedures are standardised and formalised (4-A8). Employees become specialised, non-risk-takers (4-A9). Specialised functions are added (4-A10). The stage is characterised by a decreasing growth of cash flow (4-A11).

The above described framework functions as a reference framework for this study. The authors use this framework to reflect and analyse the experiences of managers during the stages of early growth.

THE METHOD

This present research takes the form of a retrospective multiple case study. According to Yin (1989, p.23), "a case study is an empirical inquiry that: investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used".

The study analysed nine case companies located in Southern California using sequential incident technique (SIT) and semi-structured interviews implemented during autumn 2012. Three managerial viewpoints were opened in each case company for triangulation purposes – one from company management, one from operations management, and one from marketing management. The case study follows guidelines set by Yin (1989). In an overview of CIT methods, Gremler (2004) recognises several variants of CIT including SIT, created to take the sequential character of the process studied into account (see Stauss & Weinlich 1997). Case studies using SIT clarify the main sequences of the process under analysis prior to the collection of the data. This is advantageous if the process has already been defined empirically. In this study, the critical incidents are reflected in the sequential framework presented in the theoretical part. The case reports are based on ten separate case studies.

THE CASE STUDIES

The cases are summarised in the following table 2:

Table 2: The case companies

Case	Established	Technology	N. of employees	Sales (M$)	Assets (M$)
A	2009	Software	11	1,3	2,9
B	2010	Health care technology	16	2,0	20,0
C	2009	E-commerce solutions	18	2,0	6,0
D	2003	Intelligence software	15	0,5	0,4
E	2008	Investment software	16	0,7	3,0
F	2008	Recycling solution	65	12,0	250,0
G	1995	Diversified technology	30	5,7	2,5
H	2009	Biotech	7	0,3	4,5
I	2005	E-commerce solutions	24	18,9	1,6

Case1 - Case 9 descriptions (to be completed before submission of final paper…)

Summary of the parallel/ contradictory aspects related to the framework (to be completed before submission of final paper…)

DISCUSSION

The applicability of the framework will be clarified in this study; moreover, an analysis of context-specific viewpoints will be provided. It is necessary to recognise these viewpoints when using this framework in Southern California.

As an answer to *the first research question* the meta-analytical synthesis, four-stage stage self-evaluation framework for early-stage technology intensive companies is presented. The stages include: conception and development, commercialisation, expansion and stability/renewal. Table 1 presents these stages in detail. This study used the synthesis as a set of assumptions to test on ten case studies. Using the nine case studies, the authors answer *the second research question* using SIT. We analyse nine cases from Southern California to test how the experiences of the managers related to the assumptions of the framework. The results of the analysis will be presented in detail in the final paper. The results evaluate the applicability of the framework for context of Southern California by analysing the proportions and content of parallel aspects in relation to the assumptions of the framework. *The* study's *third research question* clarifies the contradictory (fresh), context-specific viewpoints of the stage framework from Southern Californian perspective. The fresh context specific viewpoints will be described to answer the third research question.

The research focus of this study is limited to the context studied. This limits the applicability of the explorative and descriptive results to other contexts.

ACKOWLEDGEMENT

The authors are grateful for the project funding supported by the Council of Oulu Region, Kerttu Saalasti Foundation, Haapavesi-Siikalatva subregion, Nivala-Haapajärvi subregion, Ylivieska subregion, Central Ostrobothnian University of applied sciences, Oulu University of applied sciences, Educational Municipal Federation JEDU and the European Regional Development Fund. We highly appreciate the support received for this study from University of California, Rady School of Management, La Jolla, CA, USA. Further, we highly appreciate the companies and persons involved in the study to share their experiences.

REFERENCES

1. Churchill NC & Lewis VL (1983) *The five stages of small business growth.* Harvard business review 61(3): 30-50.
2. Coad A (2007) *Firm Growth: A Survey.* Max Planck Institute Papers on Economics & Evolution : 1-72.
3. Coase RH (1937) *The Nature of the Firm.* Economica 4(16): 386-405.
4. Davidsson P & Wiklund J (2006) 3. Conceptual and empirical challenges in the study of firm growth. Entrepreneurship And the Growth of Firms .
5. Edvardsson B & Roos I (2001) *Critical incident techniques.* International Journal of Service Industry Management 12(3): 251-268.
6. Fisher S & Oulton T (1999) *The critical incident technique in library and information management research.* Educ Inf 17(2): 113-125.
7. Flanagan JC (1954) *The critical incident technique.* Psychol Bull 51(4): 327-358.
8. Gibrat R (1931) Les inégalités économiques. Paris, Recueil Sirey.
9. Greiner L (1972) *Evolution and revolution as organisations grow.* Harward Business Review 50(4): 37-46.
10. Gremler D (2004) *The Critical Incident Technique in Service Research.* Journal of Service Research 7(1): 65-89.
11. Hanks SH, Watson CJ & Jansen E (1991) *Toward a configurational taxonomy of the organization life cycle.* In: Hills G & LaForge R (eds) Research at the Marketing/Entrepreneurship Interface, Chicago, University of Illinois Press.
12. Hannan MT & Freeman J (1977) *The Population Ecology of Organizations.* The American Journal of Sociology 82(5): 929-964.
13. McClelland DC (1961) The achieving society. Princeton, Van Nostrand.
14. Miller D & Friesen PH (1984) *A Longitudinal Study of the Corporate Life Cycle.* Management Science 30(10): 1161-1183.
15. Muhos M (2011) Early stages of technology intensive companies. Oulu, University of Oulu.
16. Muhos M, Kess P, Phusavat K & Sanpanich S (2010) *Business growth models: review of past 60 years.* International Journal of Management and Enterprise Development 8(3): 296-315.
17. Nelson RR & Winter SG (1982) An Evolutionary Theory of Economic Change. Cambridge, Belknap Press.
18. Penrose ET (1959) The Theory ofthe Growth of the Firm. New York, JohnWiley&Sons.
19. Salonen A (1995) International growth of young technology-based Finnish companies. Helsinki, Finnish Academy of Technology.

20. Sandberg WR & Hofer CW (1982) *A strategic management perspective on the determinants of new venture success.* In: Vesper KH (ed) Frontiers of Entrepreneurship Research. Wellesley, Babson College: 204-237.
21. Stauss B & Weinlich B (1997) *Process-oriented measurement of service quality.* European Journal of Marketing 31(1/2): 33-55.
22. Storey DJ & Tether BS (1998) *Public policy measures to support new technology-based firms in the European Union.* Research Policy 26(9): 1037-1057.
23. Tesfaye B (1997) *Patterns of Formation and Development of High-Technology Entrepreneurs.* In: Jones-Evans D & Klofsten M (eds) Technology, Innovation and Enterprise - The European Experience. London, MacMillan: 61-106.
24. Wiklund J (1998) Small Firm Growth and Performance: Entrepreneurship and Beyond. Jönköping, Jönköping University, Jönköping International Business School.
25. Williamson OE (1975) Markets and hierarchies: analysis and antitrust implications: a study in the economics of internal organization. New york, Free Press.
26. Yin RK (1989) Case study research: Design and methods. Beverly Hills, Sage Publications.

Dr. Matti Muhos is a Research Director at the Oulu Southern Institute at the University of Oulu. He holds a Doctoral in Industrial Engineering and Management. He participates in the editorial processes of several international journals as an associate editor, quest editor and advisory board member. His primary research areas are growth and internationalisation of technology intensive SMEs including configurations and management viewpoints, development of micro-companies and SMEs, technology intensive companies, agility, internationalisation processes and technology management. He has worked on several international projects and has written more than 60 publications in the forms of journal papers, book contributions, refereed conference papers and technical papers.

Professor Pekka Kess is the Head of the Department of Industrial Engineering and Management (DIEM) at the University of Oulu, Finland. He has extensive managerial experience from both universities and industrial enterprises. He is an active project evaluator and manager in international research and development projects. His research areas are strategic management, production organisations, knowledge management and quality management.

Dr. Lada Rasochova is the executive director of the California Institute for Innovation and Development (CIID) and the managing director of the Rady Venture Fund (RVF) at the Rady School of Management at the University of California San Diego. Dr. Rasochova received her Ph.D. in molecular, cellular, and developmental biology from Iowa State University and MBA from the Rady School of Management at UC San Diego.

Delbert F. Foit, Jr. is a lecturer at University of California San Diego Rady School of Management. He has an extensive industrial and entrepreneurial experience in the fields of… (to be completed)

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

STUDY ON RESOURCE ALLOCATIONS FOR SUSTAINABLE COMPETITIVE ADVANTAGE

Prof. Josu Takala, University of Vaasa, Department of production/Industrial management, Po.box 700, FI-65101, Vaasa, Finland
josu.takala@uwasa.fi

Daryna Shylina, University of Vaasa, Department of production/Industrial management, Po.box 700, FI-65101, Vaasa, Finland
u96735@student.uwasa.fi

Teppo Fross, TVT Asunnot Oy, Finland
Email: teppo.forss@tvt.fi

Johannes Malmi, TVT Asunnot Oy, Finland
Email:johannes.malmi@tvt.fi

ABSTRACT

Today's concern and problem for most of the companies is the way of surviving and prospering in current and future periods of time in the marketplace.Sustainable competitive ability can be one of the ways of adaptation to the global business and rapid environment requirements.Operational competitiveness is not easy to be sustainably improved because of unpredictable environment situations, such as continuous increasing customer needs, global competitive environment, rapid and unpredictable changes in government policy, company crisis during significant changes etc. However, it is possible to make adaptive adjustments on operations strategy level in dynamic business environment and to become competitive enough compared to the competitors. The purpose of this paper is to define and assess sustainable competitive advantage and the direction of development in housing business. It can be analyzed by three core factors, i.e. Sense and Respond (S&R) methodology, Analytical Hierarchical Process (AHP) as well as Sustainable competitive advantage (SCA) method. This study also focuses on applying S&R method in order to optimize operational competitiveness as well as defining the competitive priorities of the case company. The analysis results show the critical areas in different departments of the case company, which can help the managers to make quick decisions. In addition, they reveal that during the crisis the resource allocation is continuously changing and therefore the operation strategy of the case company is not well defined as well as competitive advantages are not enough sustainable.

Keywords: Sustainable Competitive Advantage, Competitive priorities, Operation strategies, Housing business, Sense and Respond, Analytical Hierarchical process

INTRODUCTION

The aim of operations strategy is providing a broad framework for defining how it prioritizes and utilizes its own resources to have a sustainable competitive advantage in the marketplace. Competitiveness is the ability and performance of an organization to offer products and/or services that can meet market needs and requirements, the ability to react faster compared to your competitors to the market changes and needs (Krugman, 1994). Although most of the companies show their own goals from the aspect of customer satisfaction or level of quality, their primary aim is to be better than their competitors. One of the methods to gain a competitive advantage is by developing the current functions of operations management in a more effective way than their competitors. Moreover, the developing of production process will bring more benefits and competitive edge for a company.

The purpose of this paper is to define and assess sustainable competitive advantages and the direction of development in housing business. Analysis of the operational competitiveness will be held by three core factors: Sense and respond (S&R) methodology, Sustainable Competitive Advantage (SCA) method and Analytical Hierarchical Process (AHP) method. The term Sense and Respond (S&R) first appeared and defined as a business concept in 1992 by Haeckel (1992). However the S&R thinking was developed by Bradley and Nolan (1998) and Markides (2000) in order to have a possibility and method to analyze the dynamic of business performances and strategies. Critical Factor Index (CFI) and Balanced Critical Factor Index (BCFI) models in S&R method are introduced to optimize strategic adjustments, which can give supports during the fast strategic decision-making process, and in addition they provide the information about critical attributes which should be strengthened. S&R method is presented as a questionnaire, which was sent to the case company, where five departments were participating in the survey.

According to SCA, Rautiainenand Takala (2003) defines it as “risk level (probability in percentage) for that the operations strategy should essentially be improved to sustain the operations performance competitiveness during the period considered”. The developing of SCA goes by integrating reciprocally global operations strategy with resource allocations. This method includes the validation based on several methodologies: Manufacturing Strategy Index (MSI) (Takala et al., 2007) and method of detection of a company’s preferable strategytype through utilization of S&R methodology.

RESEARCH METHODOLOGIES

Operation strategies

Raymond Miles and Charles Snow (1978) identified and developed a new strategy typology from the study of business strategies which is based on the new product development and penetration and adaptability to new markets or to uncertain competitive environment. Companies compete differently in the market as they estimate their environments on a distinctive basis and make resource allocation decisions based on these views. Miles and Snow (1978) classified business units into four strategic types, such as prospector, analyzer, defender and reactor.

Prospector is a strategy in which a company continually innovates and improves the product by finding and exploiting new market opportunities. This competitive strategy is considered to be as a creator of changes in the market place. They are able to respond quickly to existed or early signals concerning areas of opportunities and are keen to be the first in entering into a new product/market area (Flouris and Oswald, 2006).

Analyzer is a strategy, which helps organizations to keep the high level of competency by analyzing and imitating the competitive advantages of other organizations. Analyzer company is thought to be intersection of defender and prospector strategies. Analyzer can take some good ideas from prospector strategy and as a result successfully implement them in the marketplace. There is a necessity in flexibility as well as stability in the business processes and market (Daft, 2008).

Defender is a strategy in which company is looking for market stability and tends to have a narrow product market. Compared to prospectors, the main concern of defenders is stability and economy. This strategy does not search for new market places, tries to keep the current customers. They pay attention primarily on internal efficiency and controlling the high-quality of production process for already existed customers. Therefore defender companies become highly dependent on their narrow product/market area. In order to protect its domain, defender companies use lower prices, high quality of products and better delivery (Flouris and Oswald, 2006).

Reactor is strategy which does not have a consistent strategic plan or plan about the means of competing in the marketplace. According to sustainable competitive advantage, reactor strategy is not recommended as a competitive strategy. It is passive in dealing with most issues such as responding to environmental threats and opportunities. As long as a top manager does not define a strategic plan or explicit mission, vision or goals, as a result company acts in order to meet immediate and important for this moment needs (Daft, 2008).

Competitive priorities

Looking at operations strategies from companies' perspective, it can be seen that different organizations in different sectors of industry focuses on different competitive priorities and capabilities. The main idea of success in operations strategy plan lies on identifying, prioritizing the choices and in guidance the ensuring trade-offs. Moreover, the decision making in the company is primary based on market needs and requirements. According to Slack et al. (2004) four competitive priorities are defined, such as quality, cost, time and flexibility.

Quality advantage means "doing things right", but the things which will be done in a right way will vary according two directions: design quality and process quality. Design quality means the set of features which product and/or service has. It is something that a customer finds very easy to make his/her own conclusions and judgments about product and/or service. While process quality is vital as well as design quality because it is related directly to the quality inside the operations and it can lead to cost reduction and dependability increase. If the company makes fewer mistakes during the operation process, then the less time will be spend for fixing these mistakes and less dissatisfaction and confusion will be spread inside the company.

Companies in which main competitive advantage is cost usually follow the elimination of all waste. If there is a low cost in production processes of goods and services, the lower price can be presented as a result to final customer. However, such a situation does not always guarantee profitability and success for a company (Chase et al., 2007).

Time can be related to quick delivery and delivery in time. Being competitive enough in the market means that the company has ability to deliver more quickly the product or service rather than its competitors. Quite simple rule that the faster the company delivers the product or service, the faster customer buys it and consequently will return to buy more. It can be reached by quick inside respond to external customers: fast decision-making, movement of material, and information. Also, delivery in time brings to the company the dependability for the organization and respect and satisfaction from customers (Slack et al., 2004).

Flexibility as a competitive advantage means the ability of the company to produce different types of products, improve the current product, and introduce new products to market and quick respond to customer need and requirements. According to internal aspect, flexible operations can also bring following advantages: speed up response, time saving, and dependability maintaining (Slack et al., 2004).

Sense and Respond method

As a business concept sense and respond (S&R) was firstly described in 1992 by Haeckel (1992) in Management Review article. However, S&R thought was developed further by Bradley and Nolan (1998) and Markides (2000) in order to analyze and describe dynamic business strategies. This method is based on the tools which can help to handle company's future obscurities. In other words, S&R helps companies to expect, foresee, adapt and respond to continually changing environment situations. The method evaluates business operations and customer needs in the organization, which does not mean that it shows the future incomes. The main idea of this method is to react to signals as fast as possible and also to see the weakened, continually changing or stable business attributes of the company.

Rautiainen and Takala (2003) were developed S&R questionnaire method based on the S&R methodology. Further developing made by Ranta and Takala (2007) paid attention on controlling and evaluating the company's internal and external attributes from experience and expectation perspective. The main role of this questionnaire is to develop a fast and reliable way of defining market needs and to react to those requirements in such a way that current important attributes are developing and changing towards right direction.

The questionnaire includes two forms: one evaluates the company's daily operations (OP), and the other one – company's activities in a more general level (BSC). Operational form evaluates Knowledge & Technology Management, Processes & Work flows as well as organizational and information systems. The aim of this form of the questionnaire is to define the critical factors which effect on production process of the company. Balanced score card (BSC) questionnaire defines and evaluated the company's external structure, internal process, learning and growth, trust and business performance. According to Kaplan and Norton (2005) a BSC helps the companies to answer into tree critical performance questions such as

how customers see the company in general; what must we distinguish in ourselves; how can the company continue to improve, develop and create additional value.

The results can be indicated as "traffic lights". For example, red attributes mean that they are critical and need to be reviewed again and put some resources. Green indicates that the attributes are in order. Yellow attributes mean that results are scattered and respondents have different understanding and view about the situation in the company. Balances Critical Factor Index (BCFI) which was developed from Critical Factor Index (CFI) is considered to be one of the main tools in detection of the critical factors.
CFI diagram includes such indexes which need to be calculates: gap index, average of expectations, average of experiences, importance index, performance index, direction of development past and future, CFI, BCFI and Scaled Critical Factor Index (SCFI):

$$\text{Gap Index} = \left| \frac{Avg\{experience\} - Avg\{expectation\}}{10} - 1 \right| \quad (1)$$

$$\text{Direction of development index} = \left| \frac{Better\% - Worse\%}{100} - 1 \right| \quad (2)$$

$$\text{Importance index} = \frac{Avg\{expectation\}}{10} \quad (3)$$

$$\text{Performance index} = \frac{Avg\{experience\}}{10} \quad (4)$$

$$\text{SD expectation index} = \frac{Std\{expectation\}}{10} + 1 \quad (5)$$

$$\text{SD experience index} = \frac{Std\{experience\}}{10} + 1 \quad (6)$$

$$\text{CFI} = \frac{Std\{eperience\} * Std\{expectation\}}{GapIndex * DirectionOfDevelopmentIndex * Important Index} \quad (7)$$

$$\text{BCFI} = \frac{Std\{experience\} * Std\{expectation\} * PerformanceIndex}{Importance Index * GapIndex * DirectioOfDevelopmentIndex} \quad (8)$$

$$\text{SCFI} = \frac{\sqrt{\frac{1}{n} * \sum_{1}^{n} [experience(i) - 1]^2} * \sqrt{\frac{1}{n} * \sum_{1}^{n} [expectation(i) - 10^2} * PerformanceIndex}{Importance Index * GapIndex * DevelopementIndex} \quad (9)$$

The most important indexes are CFI, BCFI and SCFI because they help to find the critical attributes and areas of the company. BCFI can be considered as the same index as CFI but it is calculated by performance index. Moreover, BCFI is the most useful and used index in order to define the most critical factors which have significant influence on the whole company's performance. SCFI index main aim is to solve the problems that happen when the respondent sample is too narrow and limited.

The value of these critical indexes can be interpreted in such a way that all attributes with a value below one can be considered to be critical and put more resources on it. The more value is going into the direction of zero the more critical attribute is. The value one means that the attribute is an optimal whereas the attribute with value above one is considered to be "high performer". However the "high performer" does not necessarily mean that there is a high performance in this area, it only indicates that expectations are met by the experience and the direction of development is higher than then one

Sustainable Competitive Advantage method

According to Peteraf and Barney (2003) the "company has a competitive advantage when it is able to create more economic value than the marginal (break-even) competitor in its product market". Competitive advantages in the company have two characteristics as temporary and long lasting periods of time. Based on resource logic, when the company has a sustained competitive advantage then it means creating more economic value than the marginal firm in the marketplace while other companies or competitors cannot copy and implement these benefits in its strategy.

The sustainable competitive advantage does not focus only on a company's competitive positions which are already existing and operating in the marketplace. According to Baumol, Panzar and Willing (1982) a company's competition is considered to contain not only its current competitors, but also there should be enough attention on the potential competitors, which will enter a marketplace at some future date.

In order to implement and identify sustainable competitive advantage (SCA) in the company, the S&R method with operations strategies and AHP with calculated competitive priorities are used. SCA can provide the basis of implementations of highly competitive operations strategy for managing the business situation in the marketplace.

In order to calculate SCA there three methods are used: MAPE, RMSE, and MAD. If SCA is between 0 to 1, and there are more SCA resulting value, situations is the better.

MAPE (absolute percentage error): SCA = 1- SUMi (ABSi ((BS-BR) / BS)) (10)
RMSE (root means squared error): SCA = 1- (SUMi ((BS-BR) / BS)^2)^1/2 (11)
MAD (maximum deviation): SCA = 1-MAX (ABSi ((BS-BR) / BS)) (12)

Analytic Hierarchy Process

According to Saaty (1980) the Analytic Hierarchy Process (AHP) method which allows considering qualitative and quantitative measured to evaluate a big amount of attributes. The main purpose of AHP method which is used in the empirical part is that to analyze questionnaires and calculate the weighting of the main criteria which are competitive advantages, namely cost, quality, time and flexibility. AHP method uses pairwise comparison among all the factors to support decision-making process (Rangone, 1996). It explores the degree of importance of the attributes and the main competitive priorities of the company. In order to be able to answer to use the AHP method, firstly it is necessarily to compare two factors and define the importance of each attribute, i.e. which one is more important and then to weight within the scale from 1 to 9 to indicate in what extent selected factor is more important than the other one. Inconsistence ratio (ICR) should be also calculated because it shows the validity of answers. If the ICR is less than 0.30 then the answers are considered to be valid and reliable and can be used in decision making process.The form of AHP is shown by Figure 1 below:

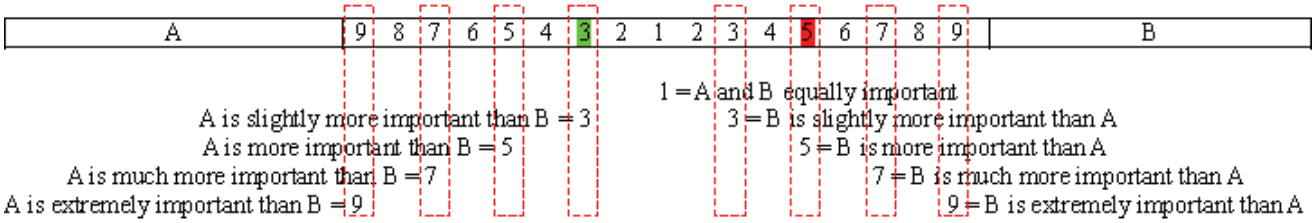


Figure 1. The form of AHP.

Case study

Case company A is a real-estate company established in 1944 and is situated and belonged to the city Turku. It is considered to be as non-profit organization, which has government restrictions concerning to operation profitability. The main idea of this company is providing rental housing. The mission of this organization is to "maintain and promote the welfare by housing means, and to contribute the local success". In addition the vision 2020 is that "A Company is the most attractive and largest of homes in the Turku region; and to provide a comfortable living experience" (Case company's official website).

The main services of case company A are offering safe and acceptable rental homes for people of different life levels, housing counseling property maintenance, care and repair, rent control, and property portfolio development. Moreover, it offers a wide range of houses such as blocks of flats, terraced houses and small private homes in Turku region. The company owns and manages approximately 11000 different types of homes, which are equipped with the basic utilities. The year turnover of the company is about 66 million euros and the general balance includes over 400 million euros. The company's market share includes approximately 10% of all dwelling and around 25% of the entire apartments in Turku region. Consequently, it can be considered as the largest individual dealer in Turku

Data collection and analysis

The data for analyzing and investigating company situation in general as well as defining the critical performance attributes was gathered by opinion survey questionnaire. The questionnaire which was developed by Ranta and Takala (2007) based on S&R method included two types of questionnaire: OP (twenty one attributes) and BSC (seventeen attributes). The questionnaire was sent to five departments of the case company, which are Hallinto, Isännöinti, Johto, Vuokraus and Vuokravalvonta. Based on answers from these departments, the data will be analyzed and interpreted. The quantity of respondents was different in each department. For example, in Hallinto there were only 4 respondents, but in Vuokraus – 9 respondents.

The value of each index in the S&R model can be obtained by such form of questionnaire (Table 1).

Performance attribute	Scale: 1=low, 10=high		Compared with competitors			Direction of development		
	Expectation (1-1)	Experience (1-10)	worse	same	better	worse	same	better
Performance 1								
Performance 2								

Table 1. Format of the questionnaire (adapted from Ranta and Takala (2007)).

RESULTS

It is reasonable to start from tracing similarities in what the case company A expects to achieve in the future period and considers more important attribute or area for the future competitiveness. The comparison of experience and expectation in every department means that it reveals the gap between experience and expectation, where the resources should or should not be put in the future period. As there are five departments were analyzed, it can be noticed that the general trend is that expectation is more than experience. Taking Johto department from the case company A as a basic and main, Figure 2 will demonstrate the gap between experience and expectation in OP questionnaire.

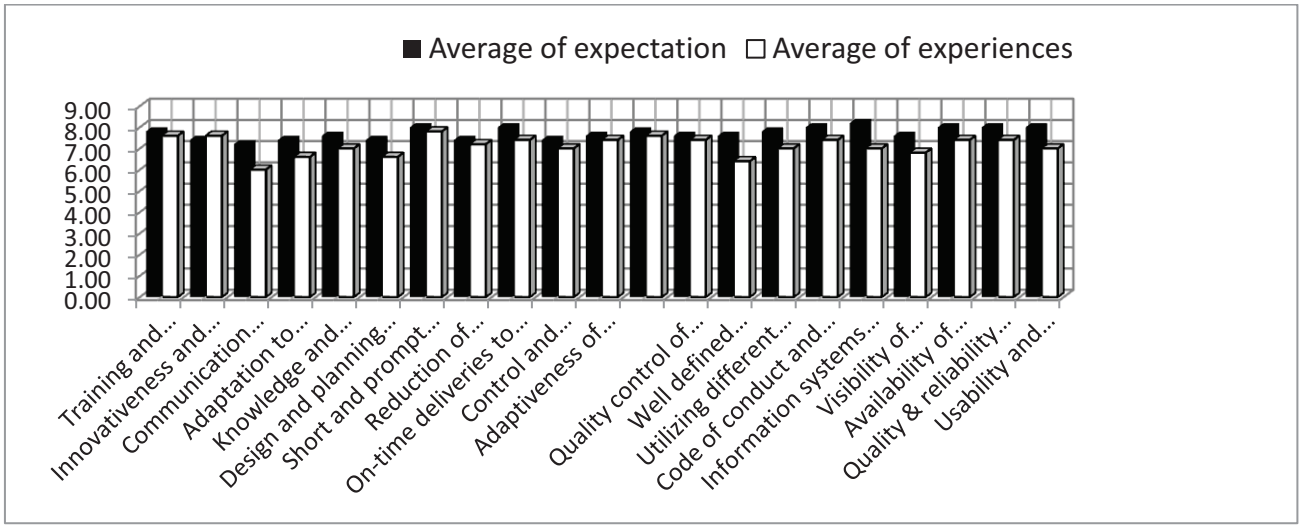


Figure 2. Resources (OP): Expectation vs. Experience in Johto department

The most interesting attributes with the biggest gap between experience and expectation are communication between different departments and hierarchy levels; well defined responsibilities and tasks for each operation; information systems support the business processes. It means that top administration feels that the company A is lacking in the mentioned attributes and expects it to improve in the future. However, there is a gap which means that one attribute (innovativeness and performance of research and development) does not need more resources put into it in the future period.

Figure 3 will demonstrate the gap between experience and expectation in BSC questionnaire.

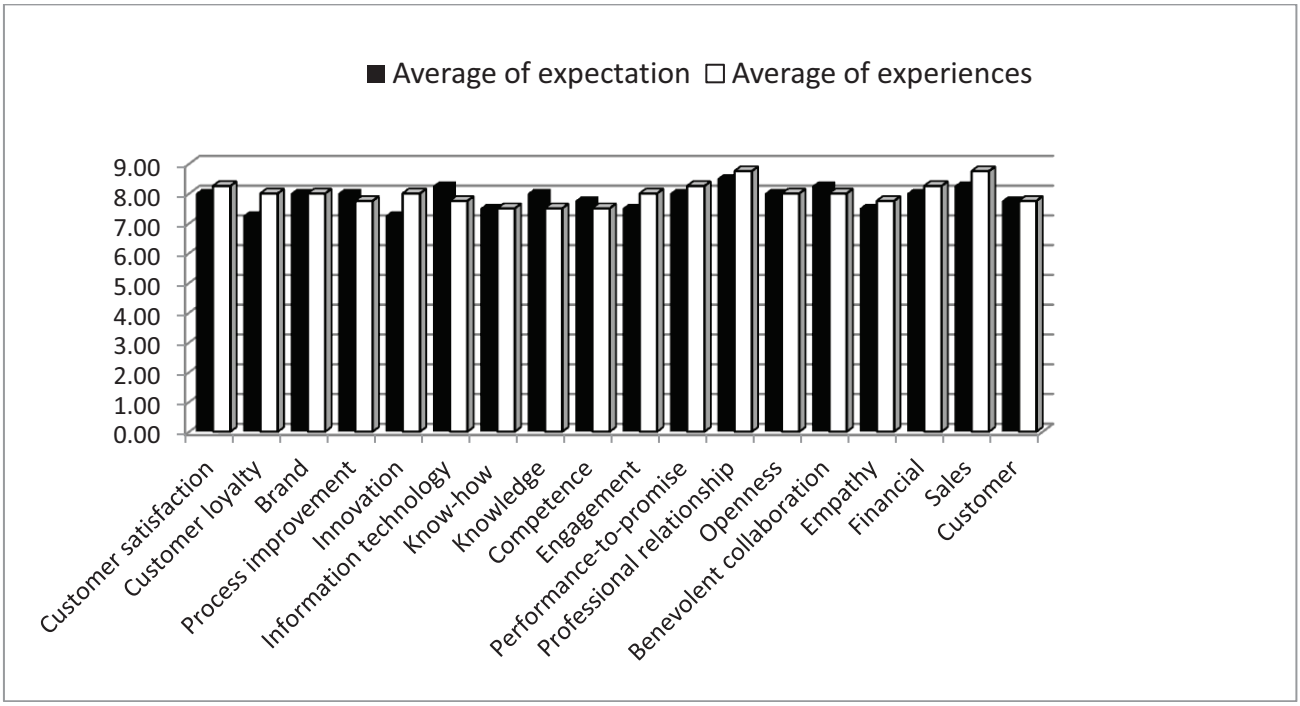


Figure 3. Performance (BSC): Expectation vs. Experience in Johto department

The matches between the expected positive changes for the company can be belonged to such attributes as information technology, and knowledge. On the other hand, it shows that there is no need in considerable improving in such areas as customer loyalty and innovation. In addition, there is no difference between expectation and experience in such attributes as brand, know-how and customer, which means that the resources should be invested continuously in the past.

After making calculations of BCFI in order to define the critical areas and attributes of the company, the general situation is stable and in future will be improved. For example, the following Figure 4 (Resources: OP) and Figure 5 (Performance: BSC) will demonstrate the comparison of BCFI in past and future and the changes of critical attributes into normalized one.

Figure 4 (Resources: OP) shows that in general the situation in future will be improved. However, there will be some unchangeable attributes in future: communication between different departments and hierarchy levels; leadership and management systems of the company; and well defined responsibilities and tasks for each operation. At the same time, in future new critical attributes will appear.
Next figure reveals the same situation as in Figure 4 (Resources: OP): it will be developed and improved. On the other hand, there are still some critical attributes, which will remain critical. They are customer loyalty, know-how, financial and customer. It means that company should pay more attention on such attributes and put more resources in improving and changing them.

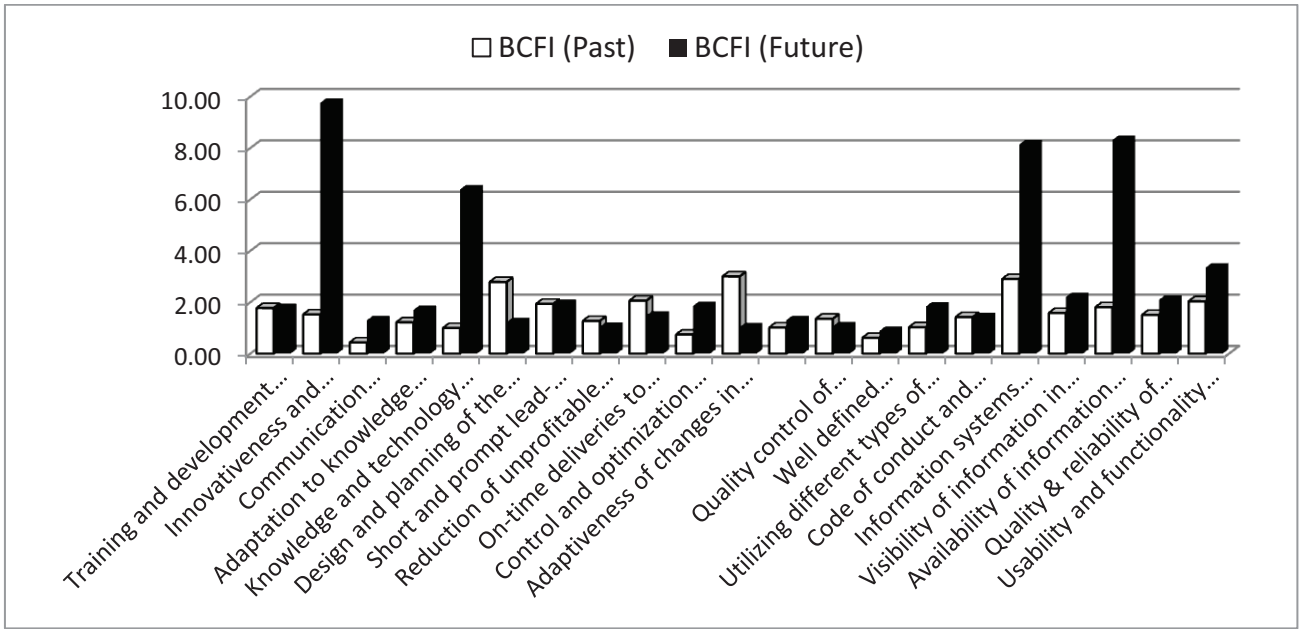


Figure 4. Comparison of BCFI past and future in Isännöinti department (Resources: OP)

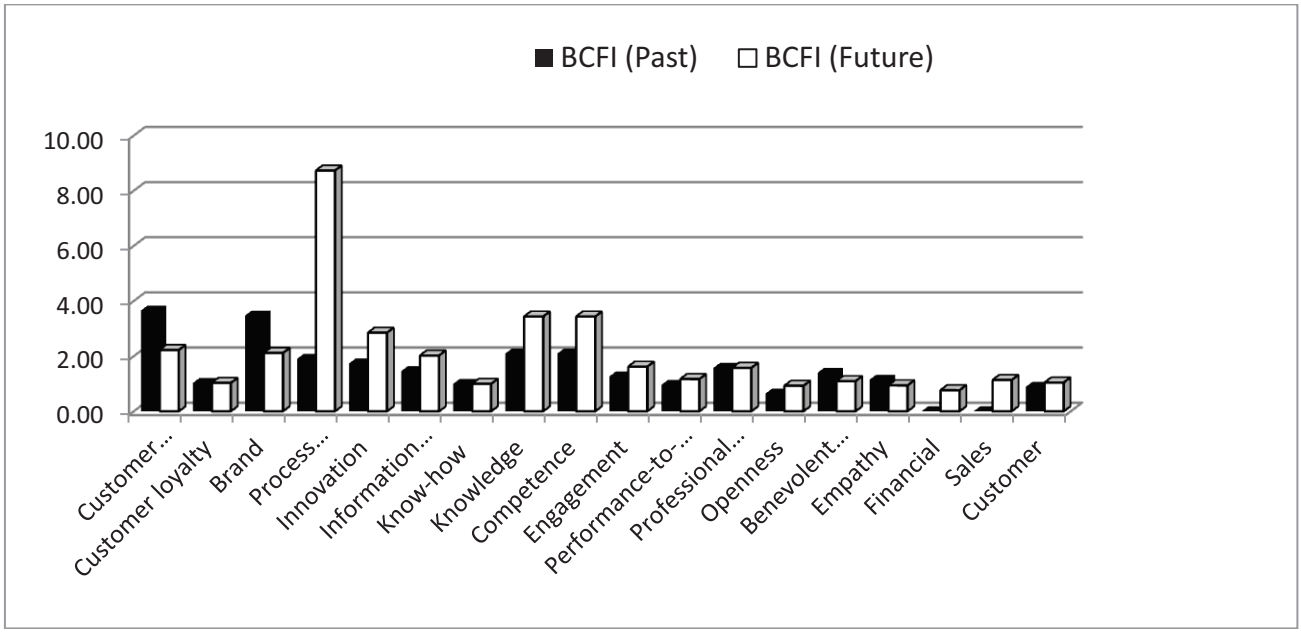


Figure 5. Comparison of BCFI past and future in Isännöinti department (Performance: BSC)

There are three main organizational strategies/types which should be defined as its features can influence on how to solve the problems and to adopt into external environment. These organizational strategies are: Prospector, Analyzer, Defender, and Reactor.

According to the results which were received after analyzing all departments' answers (Past and Future) of case company it was found out that in the Past period departments see the company strategy not in clear vision: balancing between Analyzer, Defender, and Prospector

(Table 2). However, Isännöinti, Vuokraus, and Vuokravalvonta departments are sure in Analyzer as the main operational strategy of the case company A (Table 3).

PAST							
Johto (SCFI)				Hallinto (SCFI)			
Prospector	**Analyzer**	**Defender**	**Reactor**	**Prospector**	**Analyzer**	Defender	Reactor
0.91	**0.92**	**0.92**	**0.92**	**0.93**	**0.93**	0.91	0.92

Table 2. Defining the operation strategy (PAST) based on Johto and Hallinto results

PAST							
Isännöinti (SCFI)				Vuokraus (SCFI)			
Prospector	**Analyzer**	Defender	Reactor	Prospector	**Analyzer**	Defender	Reactor
0.90	**0.98**	0.89	0.90	0.91	**0.98**	0.92	0.91

Table 3. Defining the operation strategy (PAST) based on Isännöinti and Vuorkaus results

On the other hand, in the Future period based on Hallinto, Vuokraus and Vuokravalvontaanswers company's operational strategy is considered to be Analyzer, while Johto and Isännöinti departments' opinions are not clear: balancing between Defender and Analyzer (Table 4).

FUTURE							
Jotho (SCFI)				Vuokravalvonta (SCFI)			
Prospector	**Analyzer**	Defender	Reactor	Prospector	**Analyzer**	Defender	Reactor
0.91	**0.94**	0.93	0.92	0.90	**0.97**	0.92	0.91

Table 4. Defining the operation strategy (FUTURE) based on Johto and Vuorkavalvonta results

In conclusion, general view of company is not in clear vision as different departments see the operational strategy of the whole company in different ways. In Past period case company A is balancing between Analyzer, Defender and Prospector strategies, which means that the whole operational strategy includes some features from each other. While in Future period case company A is clearly Analyzer.

After evaluation and defining the critical areas of the case company A, the next step of analyzing of this company was to define the risk level in all departments by SCA method. There are two periods were taken into the consideration: before crisis (past) and during crisis. Table 5 below shows that Isännöinti, Vuokraus and Vuokravalvonta depertments have highest risks compared to Johto and Hallinto departments, which determine unstable situation before crisis. On the other hand, Table 6 demonstrates that during crisis when some changes are implemented in the company, the risk level increased considerably, which is understandable during company changes and new strategies implementation. However, Vuokravalvonta department has the highest risk level compared to other departments which one of the reasons could be that based on BCFI results company does not invest enough resources in supporting the work of this department. Johto and Isännöinti departments have

about the same risk level, which can be explained as the company's changes have not influenced on these two departments considerably.

BEFORE CRISIS = PAST

Hallinto			
	CFI	BCFI	SCFI
MAPE	0.95	0.93	0.94
RMSE	0.97	0.95	0.96
MAD	0.97	0.96	0.97
Isännöinti			
	CFI	BCFI	SCFI
MAPE	0.87	0.88	0.87
RMSE	0.92	0.92	0.91
MAD	0.93	0.94	0.93
Vuokravalvonta			
	CFI	BCFI	SCFI
MAPE	0.85	0.89	0.89
RMSE	0.90	0.92	0.92
MAD	0.93	0.94	0.94

Johto			
	CFI	BCFI	SCFI
MAPE	0.97	0.92	0.90
RMSE	0.94	0.95	0.94
MAD	0.96	0.96	0.95
Vuokraus			
	CFI	BCFI	SCFI
MAPE	0.87	0.87	0.88
RMSE	0.92	0.91	0.91
MAD	0.93	0.93	0.94

Table 5. Comparison of risk levels in all departments before crisis.

DURING CRISIS

Hallinto			
	CFI	BCFI	SCFI
MAPE	0.82	0.77	0.76
RMSE	0.89	0.86	0.85
MAD	0.92	0.89	0.89
Isännöinti			
	CFI	BCFI	SCFI
MAPE	0.87	0.86	0.81
RMSE	0.92	0.91	0.88
MAD	0.94	0.93	0.91
Vuokravalvonta			
	CFI	BCFI	SCFI
MAPE	0.79	0.77	0.78
RMSE	0.87	0.86	0.87
MAD	0.90	0.89	0.90

Johto				
	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.97	0.83	0.83	0.89
RMSE	0.91	0.90	0.90	0.93
MAD	0.93	0.92	0.92	0.95
Vuokraus				
	CFI	BCFI	SCFI	
MAPE	0.76	0.76	0.77	
RMSE	0.85	0.85	0.86	
MAD	0.89	0.89	0.89	

Table 6. Comparison of risk levels in all departments during crisis

CONCLUSIONS

The main purpose of this study is to implement sustainable competitive advantage through resource allocation in case company A operating in housing market, which uses the S&R methodology in order to find critical factors in experiences and expectations between different departments and to see the general picture of the company.

In the study it was presentedvarious levels of the organization which are performing in accordance with common strategy. Case company A operates mainly as a Analyzer including other types of operational strategies in the regular housing market – the company is operating in two types of product-market domains: stable and changing; the competitive level of such a combination of strategy focuses on flexibility and cost, while balancing between quality and time. However, in the past it was confusion about the main operational strategy: balancing between Analyzer, Prospector and Defender. Case company aim is to keep strong position in Prospector type of company in social housing market, which requires a lot of work and a lot of changes in the operation level of the company. Prospector type of a company can be considered as a strong competitor performing in such market area without any competitors.

In order to survive within the global competition, the critical attributes should be determined in the company. Since there are many variables involved and the period when the questionnaire was sent is changeable and unstable, the overall situation in future is expected to be improved, even though new critical factors will appear. The better situation can be seen in the Vuokravalvonta, Isännöinti, and Vuokraus departments.

In the final analysis, there were two periods taken into the consideration during the calculation of risk levels by SCA method, where before crisis period generally the whole situation in the company is normalized and stable, while the crisis has started, the risks increased. Crisis brings a lot of changes in the company and therefore the risk level is increasing, which can be appropriate situation. However, the highest risk level is in Vuokravalvonta department, which can be the reason to go deeply into the department performance and to reorganize or to invest more resources into this department.

In the future research, several ideas can be proposed as follows:

- as there were interviews made in 5 departments of the company, not everybody could give appropriate answers to the questions in questionnaire, which might give a wrong picture of business processes of company. Therefore respondents should be chosen more accurate;
- as S&R, AHP and SCA methodologies show only outcomes of the company analysis, but not the reasons why the company is facing the problems and why there are critical factors in there. Therefore, after making the full analysis based on the questionnaire, the interview should be used in order to see the complete process: income – outcome;
- SCA method should be improved by defining one tool and technique for making better calculations and conclusions.

REFERENCES

1. Baumol, W. J., Panzar, J. C. and Willig, R. P. (1982),*Contestable markets and the theory of industry structure*, Harcourt Brace Jovanovich, New York, NY.
2. Bradley, S.P. and Nolan, R. L.(1998),*Sust: Capturing Value in the Network Era*, Harvard Business School Press, Boston.
3. Chase, R. B., Jacobs, F. R. and Aquilano, N. J. (2007),*Operations Management for Competitive Advantage with global cases.* 11th ed.,McGraw-Hill/Irwin, NewYork, NY.
4. Daft, R. L. (2008),*Organization theory and design*, South-Western Cengage Learning, Mason, OH, USA.
5. Flouris, T. G., and Oswald, S. L. (2006),*Designing and executing strategy in aviation management*, Ashgate Publishing Limited, England.
6. Haeckel, S.H. (1992),"From "make and sell" to "sense and respond"",*Management Review*,Vol. 81No. 10, pp.3-9.
7. Kaplan, R. S., and Norton, D. P.(2005),"The Balanced Scorecard: Measures that drive performance (cover story)",*Harvard Business Review*, Vol. 83 No. 7/8, pp. 172-180.
8. Krugman, P. (1994),"Competitiveness: A dangerous obsession",*Foreign affairs*, Vol.73, pp. 28-34.
9. Markides, C. (2000),*All the right moves: a guide to crafting breakthrough strategy*, Harvard Business Press, USA.
10. Miles, R., and Snow, C. (1978), "Organizational Strategy, Structure, and Process",*Academy of Management Review*, Vol. 3 No. 3, pp. 546-563.
11. Peteraf, M. A., and Barney, J. B. (2003), "Unraveling the resource-based triangle",*Managerial and Decision Economics*, Vol. 24, 309-323.
12. Rangone, A. (1996),"An analytical hierarchy process framework for comparing the overall performance of manufacturing departments",*International Journal of Operations & Production management*, Vol.16 No. 8, pp. 104-119.
13. Ranta, J. M., and Takala, J. (2007),"A holistic method for finding out critical feature of industry maintenance services",*International Journal of Services and Standards*, Vol.3 No. 3, pp. 312-325.
14. Rautiainen, M. and Takala, J. (2003),"Measuring customer satisfaction and increasing it by choosing the right development subjects", paper presented at the 2nd International Conference on Logistics & Transport, LOADO"2003", High Tatras, Slovak Republic.
15. Saaty, T. L. (1980),*The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation*, McGraw-Hill, New York, NY.
16. Slack, N., Chambers, S., and Johnston, R. (2004),*Operations Management*. 4th edition, Pearson Education, Harlow.
17. Takala, J., Kamdee, T., Hirvela, J. and Kyllonen, S. (2007),*Analytic calculation of global operative competitiveness*,in Proc, IAMOT 1569041789, IAMOT, the 16th International Conference on Management of Technology; Management of Technology for Service Economy, International Association for Management of Technology, Orlando, Florida, USA.

APPENDIX

Performance attribute	Scale: 1=low, 10=high		Compared with competitors			Direction of development		
	Expectation (1-1)	Experience (1-10)	worse	same	better	worse	same	better
Performance 1								
Performance 2								

Table 1. Format of the questionnaire (adapted from Ranta and Takala (2007)).

PAST							
Johto (SCFI)				Hallinto (SCFI)			
Prospector	**Analyzer**	**Defender**	**Reactor**	**Prospector**	**Analyzer**	Defender	Reactor
0.91	**0.92**	**0.92**	**0.92**	**0.93**	**0.93**	0.91	0.92

Table 2. Defining the operation strategy (PAST) based on Johto and Hallinto results

PAST							
Isännöinti (SCFI)				Vuokraus (SCFI)			
Prospector	**Analyzer**	Defender	Reactor	Prospector	**Analyzer**	Defender	Reactor
0.90	**0.98**	0.89	0.90	0.91	**0.98**	0.92	0.91

Table 3. Defining the operation strategy (PAST) based on Isännöinti and Vuorkaus results

FUTURE							
Jotho (SCFI)				Vuokravalvonta (SCFI)			
Prospector	**Analyzer**	Defender	Reactor	Prospector	**Analyzer**	Defender	Reactor
0.91	**0.94**	0.93	0.92	0.90	**0.97**	0.92	0.91

Table 4. Defining the operation strategy (FUTURE) based on Johto and Vuorkavalvonta results

BEFORE CRISIS = PAST

Hallinto			
	CFI	BCFI	SCFI
MAPE	0.95	0.93	0.94
RMSE	0.97	0.95	0.96
MAD	0.97	0.96	0.97
Isännöinti			
	CFI	BCFI	SCFI
MAPE	0.87	0.88	0.87
RMSE	0.92	0.92	0.91
MAD	0.93	0.94	0.93
Vuokravalvonta			
	CFI	BCFI	SCFI
MAPE	0.85	0.89	0.89
RMSE	0.90	0.92	0.92
MAD	0.93	0.94	0.94

Johto			
	CFI	BCFI	SCFI
MAPE	0.97	0.92	0.90
RMSE	0.94	0.95	0.94
MAD	0.96	0.96	0.95
Vuokaus			
	CFI	BCFI	SCFI
MAPE	0.87	0.87	0.88
RMSE	0.92	0.91	0.91
MAD	0.93	0.93	0.94

Table 5. Comparison of risk levels in all departments before crisis.

DURING CRISIS

Hallinto			
	CFI	BCFI	SCFI
MAPE	0.82	0.77	0.76
RMSE	0.89	0.86	0.85
MAD	0.92	0.89	0.89
Isännöinti			
	CFI	BCFI	SCFI
MAPE	0.87	0.86	0.81
RMSE	0.92	0.91	0.88
MAD	0.94	0.93	0.91
Vuokravalvonta			
	CFI	BCFI	SCFI
MAPE	0.79	0.77	0.78
RMSE	0.87	0.86	0.87
MAD	0.90	0.89	0.90

Johto				
	CFI	BCFI	SCFI	BCFI T/K
MAPE	0.97	0.83	0.83	0.89
RMSE	0.91	0.90	0.90	0.93
MAD	0.93	0.92	0.92	0.95
Vuokaus				
	CFI	BCFI	SCFI	
MAPE	0.76	0.76	0.77	
RMSE	0.85	0.85	0.86	
MAD	0.89	0.89	0.89	

Table 6. Comparison of risk levels in all departments during crisis

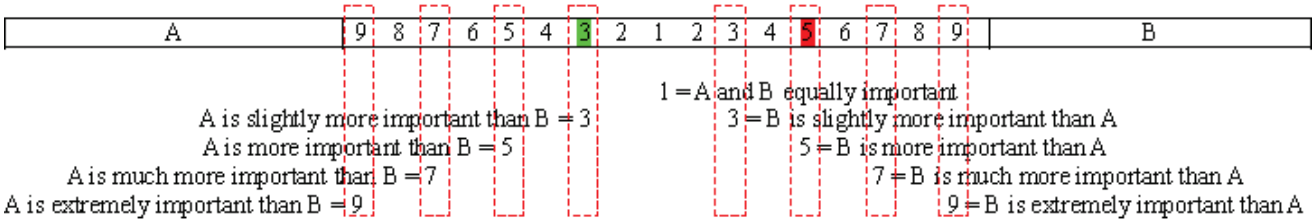


Figure 1. The form of AHP.

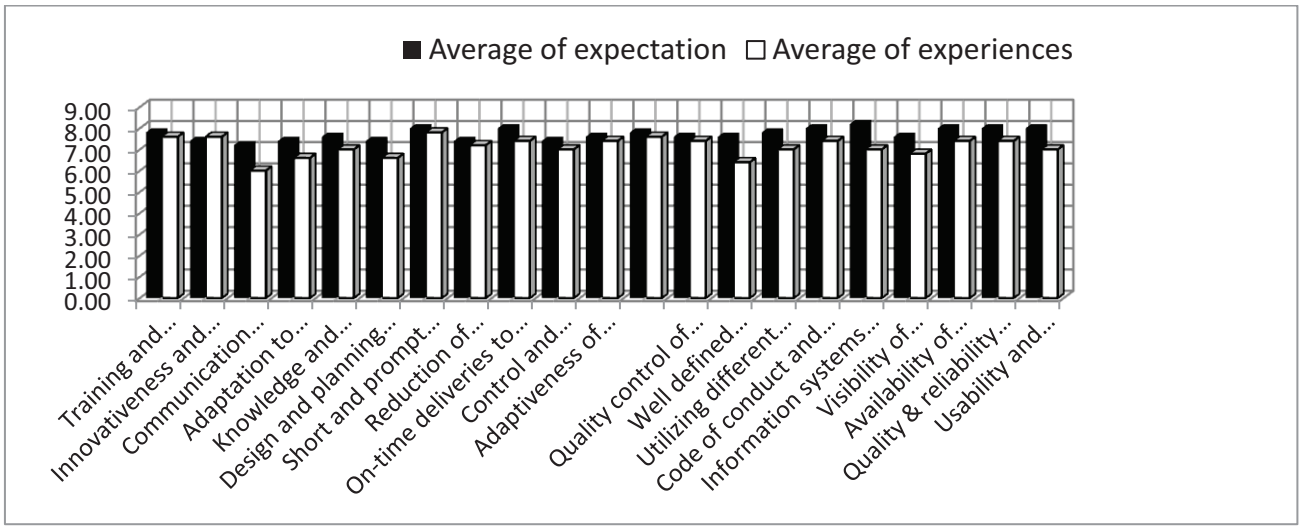


Figure 2. Resources (OP): Expectation vs. Experience in Johto department

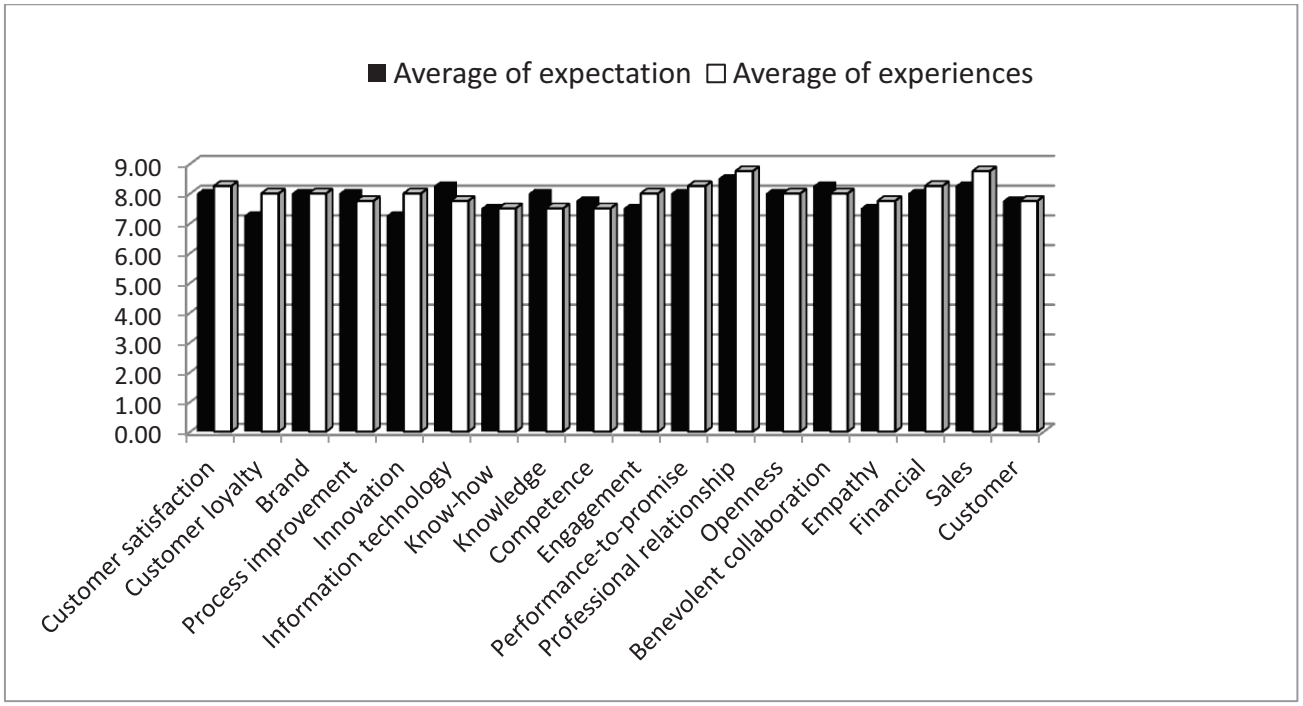


Figure 3. Performance (BSC): Expectation vs. Experience in Johto department

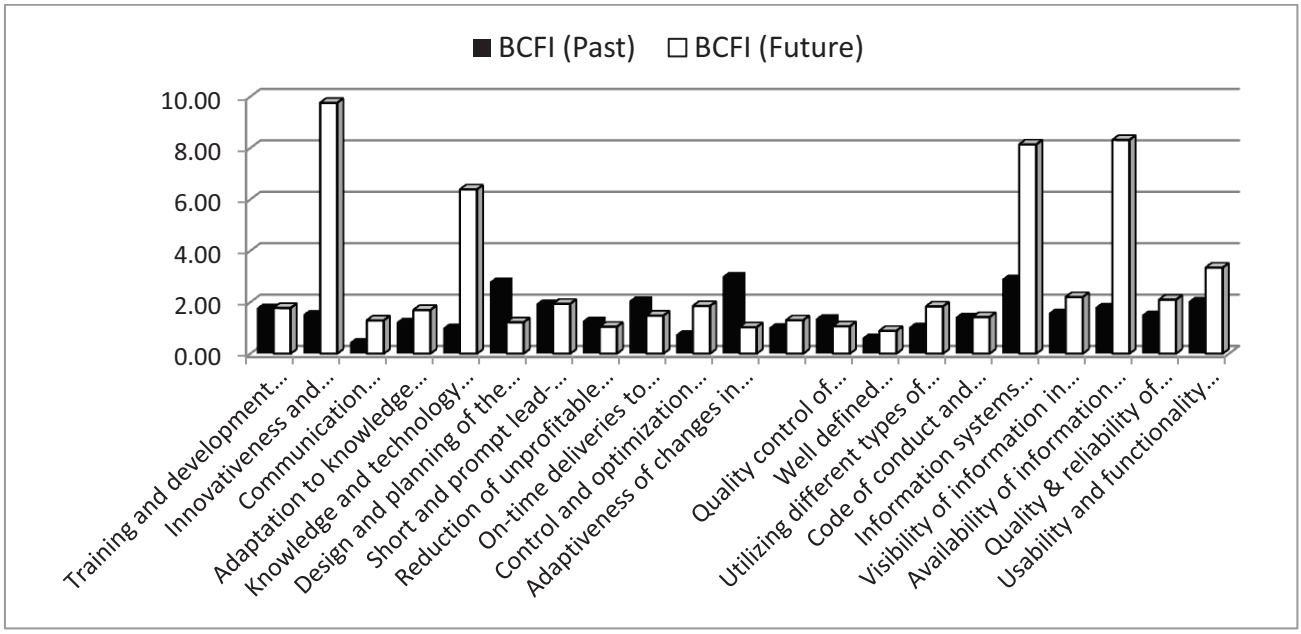


Figure 4. Comparison of BCFI past and future in Isännöinti department (Resources: OP)

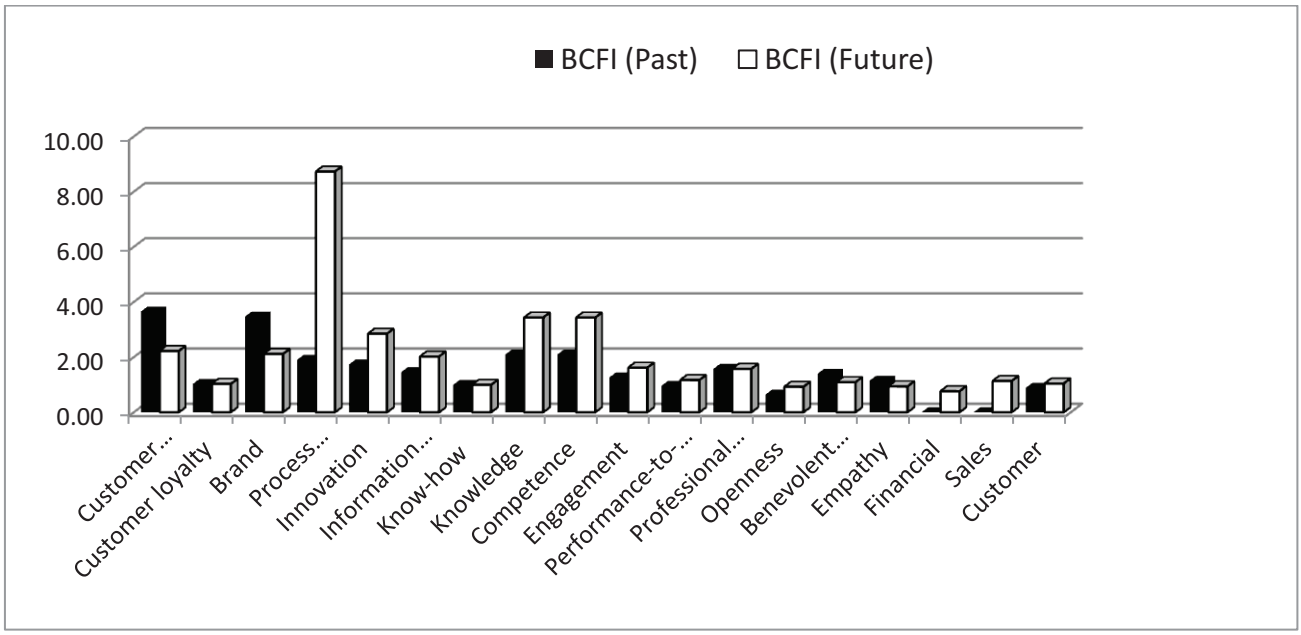


Figure 5. Comparison of BCFI past and future in Isännöinti department (Performance: BSC)

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

A DEMERIT CONTROL CHART FOR CUSTOMER SATISFACTION SURVEY

Worlaluck Jankrajang, Department of Industrial Engineering, Faculty of Engineering, Kasetsart University, Thailand
Email: worlaluck@eau.ac.th

ABSTRACT

Purpose: *The main purpose of this article is to present the advances of control chart techniques in nonmanufacturing processes. Specifically, we present a new approach to monitor service quality with time. This study uses the performance of the demerit control chart to monitor the negative responses or nonconformities with respect to the service quality characteristic. These charts assign the different weight to each negative responses, regard of the degree of unfavorable.*
Design/methodology/approach: *Applying of the demerit control chart to monitor the customer survey data is discussed. The procedure of constructing the proposed chart is described by a numerical example using data collected in an assessment of library service quality at a private university in Thailand.*
Findings: *The control chart shows one sample that is above the upper control limit this could indicate that an assignable cause affected those quality characteristic. Perhaps those service offered might less than student expectation. Action should be taken to figure out how to address the issues in those items and bring the process back to the in-control condition. Applying of SPC is helpful to promote service quality.*
Originality/value: *In this study, we mention that the method to analyze the nonconforming of survey results by combine the negative responses as "nonconforming" are not applicable. This paper explores new technique in service quality research and the results show that such approach can provide more realistic to monitoring a count of different categories of negative responses.*

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

MOBILE TOURISM THE HIDDEN JEWEL OF THE TOURISM INDUSTRY?

Garry Wei-Han Tan, Faculty of Business and Finance, Universiti Tunku Abdul Rahman (Perak Campus), Jalan Universiti, Bandar Barat, 31900 Kampar, Perak, Malaysia
FOWLER_1982@yahoo.com

Keng-Boon Ooi, Linton University College, Persiaran UTL, Bandar Universiti Teknologi Legenda, Batu 12, 71700, Mantin, Negeri Sembilan, Malaysia
ooikengboon@gmail.com

ABSTRACT

***Purpose**: Purchasing tourism related products and services have often been limited to either bricks-and-mortar stores or desktop computers. With the growing popularity of mobile devices (m-devices) and technological innovation in wireless networks, mobile tourism (m-tourism) is expected to emerge as the next frontier in the area of mobile commerce. While the development has present consumers with another method in purchasing and ideally realistic for acceptance in the tourism industry, the adoption rate using m-device as another purchasing channel is not widespread among consumers. Likewise, the study on the adoption of m-devices in tourism sector has also been neglected by many academicians although the findings bring immense important in tourism research. Since substantial investments are needed by organizations to develop the infrastructure and building on these critical gaps, the research addresses on the factors influencing consumers' intention to adopt m-devices as another alternative purchasing channel by developing a conceptual framework.*
***Design/methodology/approach:** Given that m-tourism is relatively a new concept, the study adapts the Unified Theory of Acceptance and Usage of Technology (UTAUT) as the main theoretical background since the model can explain up to 70 percent of behavioural intention. Additionally, the study also extends the model with two additional psychological constructs namely Personal Innovativeness in Information Technology (PIIT) and Perceived Enjoyment (PE) with the objective of increasing predictive power. The constructs were added as consumers' purchasing decision is also grounded from the person's characteristic.*
***Research implications:** The conceptual framework provides valuable information to travel related organizations, mobile developers and government agencies when strategizing their mobile marketing efforts.*
***Originality/value**: In additional, the study also extends the applicability of UTAUT in the area of m-tourism from the perspective of an emerging market.*

Keywords: Mobile Tourism, Malaysia, UTAUT, Psychological Science, Mobile Commerce
Classification: Conceptual paper

INTRODUCTION

Purchasing tourism products and services were once confined to either brick-and-mortal stores or desktop computers. However with the technological innovation in wireless networks and as mobile devices (m-devices) become more advanced in terms of processing power (Wong et al., 2012) more consumers are adopting m-devices as a new source of purchasing channel. Hence, for tourism related organizations this represents a new business model and an opportunity to employ mobile tourism (m-tourism) services within the internet (Goh et al., 2010). Langelund (2007) explained that m-devices are an ideal distribution channel in the tourism industry as the functionalities are centered on the travel value chain. Siau et al. (2001) identified four characteristic of m-devices namely ubiquity, personalization, flexibility and dissemination which makes the devices appropriate for the adoption in the tourism industry. Compared with the traditional stores or desktop computers, the adoption of m-devices as another source of purchasing channel can result in significant benefits to consumers and business communities. Scholars like Lu and Su (2009) opined that consumers can shop 'anywhere' and 'anytime' since there is no connectivity interruption. Wong et al., (2012) described that purchasing using m-devices render benefits such as convenience and time saving. Yang (2010) commented on the benefits of personalization and ubiquity using m-devices. Similarly, hotels, travel agencies and other tourism related organizations can adopt to this alternative channel to improve customer loyalty and create additional revenue streams (Kim, Park and Morrison, 2008). The channel can also serve as a strategy to differentiate the organization's product from competitors. Regardless of the contributions, the adoption of m-devices has opened up new business possibilities and has impacted every facet of consumers' lives (Luo et al., 2010). PhoCus Wright, (2013) forecasted that travel booking using m-devices in the United States alone will reach USD$ 25.8 billion by 2014.

While evidence so far suggested that consumers are indeed accessing mobile sites (m-sites) using their m-devices as another channel to book for hotel rooms, rent cars and flights (New Media Trend Watch, 2012), many consumers in Malaysia do not adopt them. In a recent survey released by Malaysia Communications and Multimedia Commission, (a government agency that focuses on the multimedia industry in Malaysia), only 8.8 percent of Malaysian have actually transacted using their m-devices (MCMC, 2012). The survey was confirmed by Chong, Chan and Ooi (2012) whereby Malaysian was reported to access m-devices mainly for information rather than for purchases. The statistics also stated that Malaysia has 36,661,000 m-devices users while the number of 3G subscribers is approximately 10,335,000 in 2011 (MCMC, 2012). With Malaysia's population estimated at 28 millions (Tan, Tan and Ooi, 2011), this shows than an average Malaysian owns more than one m-devices. While such high penetration rate exists, (i.e. the m-device users divided by the total population) surprisingly the actual number of mobile transactions remains low. Malaysia remains an interesting place to study on the adoption of mobile commerce (m-commerce) in view of the low transactions rate and despite having modern telecommunication infrastructures and technologic savvy consumers (Chong, Chan and Ooi, 2012). As browsing travel related products and services on a m-device is different from browsing a website on a computer, practitioners must understand the factors leading to this low acceptance rate in order to create a successful mobile marketing strategy. While there have been numerous work related to online purchases using m-devices, the studies are mainly related to established

markets with little perspective from emerging markets like Malaysia. Furthermore, past researches conducted on m-tourism have often confined to specific viewpoints (e.g., Ahas et al., 2007; Lee and Mills, 2010; Goh et al., 2010; Pesonen and Horster, 2012). Consequently dearth research have been investigated on consumer's intention to purchase tourism related products and services using m-devices. This is puzzling as tourism industry is closely related to a nation's progress as it contributes to the country's economy and general well-being (Goh et al., 2010). Without the viewpoint from the mobile perspective, the study on tourism is considered to be incomplete. In addition, as the platform to develop a successful mobile infrastructure can come up to millions of dollars, tourism related organizations can only reap benefits if consumers are actually adopting to this new technology (Rogoski, 2005). Hence, it is imperative for the present research to study on why consumers adopt or reject a certain Information Technology (IT).

Taking together all of these arguments and the fact that purchasing tourism related products and services using m-device is still a new concept, we decided to modify the definitions proposed by Wong et al., (2012) regarding mobile shopping (m-shopping) in Malaysia and to define m-tourism as "any monetary transactions that is related to the purchases of tourism related products and services conducted using internet-enable mobile phone/smart phone or with connectivity to the wireless telecommunication networks". As online purchases include airline tickets, rental cars and hotel accommodations (Kim, Park and Morrison, 2008), we decided to limit our study from this perspective. The study decided to integrates the psychological science construct with the Unified Theory of Acceptance and Usage of Technology (UTAUT). The integrated model will help to provide a clearer insight on the consumer's acceptance and ultimately helps to improve the quality of services among practitioners. The study offers a set of benefits. Firstly, by understanding how consumers behave online, the study helps practitioners such as travel agencies, hotels, airline organizations, government agencies, mobile developers and other tourism related organizations to further improve on their mobile websites (m-websites) so that they can device a successful mobile marketing strategy. As consumer behaves differently when compared to bricks-and-mortal stores, it is therefore important to understand what motivates them to shop virtually. Secondly, by understanding the needs and motivation leading to consumers to shop for tourism related products and services using their m-devices, the findings can also help to boast the number of tourists' arrival to Malaysia. In sum, the size and contribution of the tourism industry towards the country's GDP and the opportunities to create a number of tourism related jobs presents a considerable potential for the adoption of mobile technology and the rationality why this research should be conducted. The remainder of this paper is structured as follows. First we provide a review on the theoretical basis of our research frameworks. This is followed by the research hypotheses and our proposed research framework. Subsequently we present our implications to theory and practice. Finally the limitation, future research and conclusion are discussed.

A REVIEW OF THEORETICAL MODELS OF INFORMATION TECHNOLOGY ACCEPTANCE

In the field of Management Information Systems (MIS), there are many frameworks that have been developed to predict consumers' intention to accept new IT. The traditional frameworks proposed so far by IT, psychologists and marketing scholars include the Theory of Reason Action (TRA) (Fishbein & Ajzen, 1975), Technology Acceptance Model, (TAM) (Davis, 1989), Theory of Planned Behavior (TPB) (Ajzen, 1991) and the Diffusion of Innovation (DOI) (Rogers, 1995). However, focusing solely on the traditional frameworks may not be adequate in explaining the intention usage. Thus, some of the traditional frameworks have also been integrated to increase predictive powers. The integrated frameworks include the Decomposed Theory of Planned Behavior (DTPB) (Taylor and Todd, 1995), TAM 2 (Venkatesh and Davis, 2000) and UTAUT (Venkatesh et al., 2003). While TAM has been one of the most robust model in the explanation of IT adoptions, the model has limitations in terms of IT predictions.TAM and the extended TAM 2 can only explained up to 40 percent of the system usage (Lu, Yao and Yu, 2006). Given that m-tourism is relatively a new concept in Malaysia, the study decided to adapt the Unified Theory of Acceptance and Use of Technology (UTAUT) as the main theoretical background. According to Yang (2010), UTAUT integrates several competing models such as the TAM, TRA, TPB, DOI, combination of TAM and TPB, PC Utilization (MPTU), motivational model and Social Cognitive Theory (SCT). The model was found to outperform each of the competing models respectively. Venkatesh et al., (2003) in their explanation further commented that the direct determinants of usage intention is predicted by Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI) and Facilitating Conditions (FC) while gender, experience, age and voluntariness of use is posited to moderate the usage intention. However as the model can only explain up to 70 percent of behavioural intention (Venkatesh et al., 2003), the present study decided to integrate the framework with two psychological science constructs namely the Personal Innovativeness in Information Technology (PIIT) and Perceived Enjoyment (PE). The constructs were integrated as the motivation to purchase online products and services are influenced by the consumers' characteristic. With the integrated framework, the consumers' intention to purchase tourism related products and services can be better explained. The framework however only includes gender and age as the moderating effect since they have been validated in many IT adoption studies and to exclude voluntariness and experience. Finally, in determining the independent variable, the study decided to adopt intention than actual behaviour since m-tourism is relatively at an infancy stage in Malaysia. Therefore consumers' intention is a better measurement than actual purchase. Moreover, according to Fishbein and Ajzen (1975), there is a strong correlation between intention and actual behaviour. The study was also supported by Davis (1989) in the TAM study whereby behavioural intention is assumed to be a good indicator in predicting actual usage. See figure 1 for the proposed research framework.

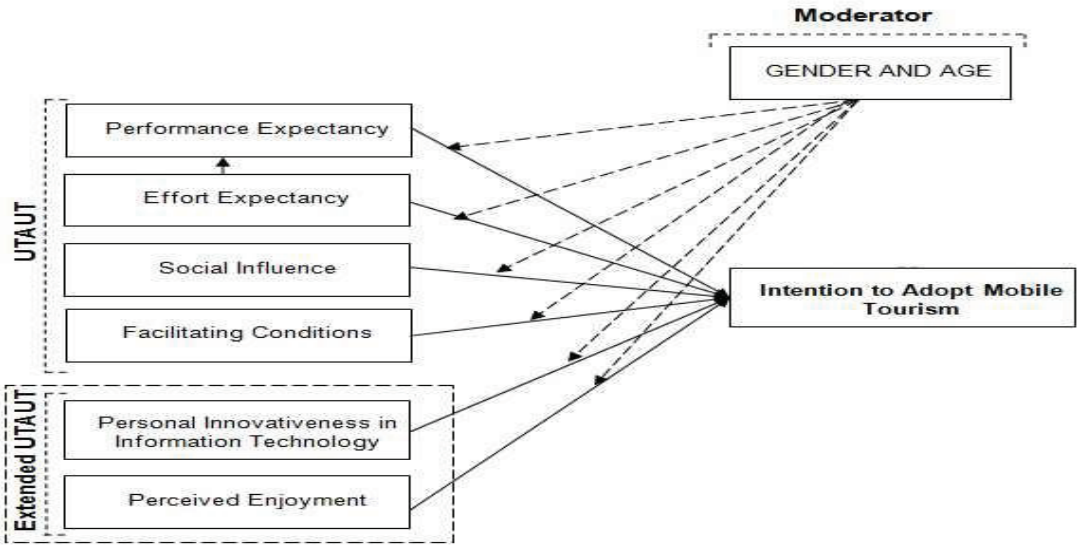


Figure 1 Proposed Research Framework

CONCEPTUAL MODEL AND PROPOSITIONS FOF M-TOURISM

The proposed research framework was drawn from the UTAUT model. The framework has also been extended with two additional psychological science constructs namely PIIT and PE to increase predictive power.

1 Performance Expectancy (PE)

Performance Expectancy (PE) reflects the individual believes whether adopting a particular system will bring benefits in terms of task performance (Venkatesh et al., 2003). The definition is similar with Perceived Usefulness in TAM (Davis, 1989) and Relative Advantage in DOI (Rogers, 1995). Many past studies have found that EE has a significant influence on the intention to use such as in the adoption of mobile services in Finland (Carlsson et al., 2006) and m-shopping in Taiwan (Lu and Su, 2009). Wong et al, (2012) in their study regarding m-shopping in Malaysia, asserts that consumers can shop anytime and anywhere due to the 'portable' and 'always on' features of m-devices. Thus the adoption translates to time saving, convenience and flexibility for consumers while on the move (Shin, 2010; Yang, 2010). If consumers perceived that there are advantages adopting m-tourism when compared to the traditional bricks-and-mortal stores, this in turn will increase the intention to adopt. Thus, the following proposition has been formulated:

Proposition 1: PE has a significant relationship with the intention to adopt m-tourism in Malaysia.

2 Effort Expectancy (EE)

Effort Expectancy (EE) reflects the individual believes that adopting a particular system would be free of effort (Venkatesh, et al., 2003). In view of the strong predictive power, the construct has been adopted in various technology frameworks such as TAM (Davis, 1989) and DOI (Rogers, 1995). EE has also been found to have significant influence in the intention to adopt various IT innovations by many scholars (Carlsson et al., 2006; Gupta, Dasgupta and Gupta, 2008). While m-tourism has beneficial outcomes, consumers may not adopt the innovation if the innovation is complex (Davis, 1989). Hong, Thing and Tam (2006) found that that ease of use is important in the study of wireless environment. M-devices are characterized with limited screen size, short battery life-span, awkward input mechanisms and other ergonomics problem which may create frustration among consumers during transactions (Wong et al., 2012).This may diminish the overall satisfaction of consumers and the perception that the technology is not easy to use. Thus, in order to improve EE, Yang (2010) in his study on m-shopping in the United States stressed on the ease of access and navigating m-sites. Additionally, consumers will adopt m-tourism if the payment transaction is straightforward and easy to learn (Shin, 2010). If consumers experience the simplicity of adopting m-tourism, they are more likely to adopt m-devices as a purchasing channel for tourism related product and services. Thus, the following proposition has been formulated:

Proposition 2: EE has a significant relationship with the intention to adopt m-tourism in Malaysia.

In UTAUT, EE has positive correlation with PE (Venkatesh et al., 2003). The findings was confirmed by many past IT studies such as on mobile data services in China (Lu et al., 2008), internet banking in Turkey (Nysveen et al., 2005) and m-shopping services in the United States (Yang, 2010). In this context of study if consumer feels that m-tourism is easy to use and requires minimum effort to operate, this will lead to a greater expectation of PE and thereby increase the intention to adopt. Thus, the following proposition has been formulated:

Proposition 3: EE has significant relationship with PE in Malaysia.

3 Social Influence (SI)

Social Influence (SI) reflects whether an individual believes that others important to them think they should or should not engage in a particular system (Carolina, Francisco and Bouwman, 2008). SI has been found to affect user's intention to adopt various IT innovations (Lu et al., 2008; Yang, 2010; Chong et al., 2010; Tan et al., 2011) because it helps to reduce the perceived risks (Rao and Troshani, 2007). According to Venkatesh et al., (2003), SI is similar with subjective norm in TRA and can be distinguished between two parts namely the external and interpersonal (Bhattacherjee, 2000). External factors includes media reports such as newspapers, television, radio, internet and expert opinions while interpersonal factors includes opinions from peers, superiors and colleagues (Carolina, Francisco and Bouwman, 2008; Wei et al., 2009). Ooi (2011)'s study found that media influence has less impact when compared to family and friends influence in Malaysia. As m-tourism is relatively a new concept in Malaysia, the rationale goes

that new consumers may shy away from adopting the technology due to uncertainties. Katz (1980) explained that consumers will then consult their social networks on his or her decision to adopt a particular innovation. If the important referents opined that the consumers should adopt, the consumers will be likely to comply. Thus, the following proposition has been formulated:

Proposition 4: SI has a significant relationship with the intention to adopt m-tourism in Malaysia.

4 Facilitating Conditions (FC)

Facilitating Conditions (FC) refers to the individual believes about the availability of resources, knowledge and training to support the adoption of a particular system and is similar with behavioral control (Venkatesh et al., 2003). According to Taylor and Todd (1995) FC has direct influence on the behavioral intention of many IT studies. Yang (2010) found that FC is positive related to the intention to adopt m-shopping in United States using 400 respondents as samples. He explained that consumers are more likely to adopt if they have the knowledge and skills to explore m-websites. In another study, Revels, et al., (2010) found that transaction fees, subscription cost and data services charges affects the adoption of mobile services. The study was supported by Teng and Lu (2010)'s study whereby cost is an important factor in the adoption of PDA phones in Taiwan. In the adoption of m-tourism in Malaysia, the cost may include the 3G subscription fees, transaction fees, handset cost and maintenance cost (Chong et al., 2010). Consumers are unlikely to adopt the particular technology if they do not have the necessary financial resources. Similarly FC also involves the availability of training and supports for consumers (Lu et al., 2008). In this context of study, even if consumers have intention to adopt m-tourism, they are unlikely to adopt the innovation when there are existing barriers. Thus to facilitate usage, the obstacles should be removed (Venkatesh et al., 2003). Hence, the following proposition has been formulated:

Proposition 5: FC has a significant relationship with the intention to adopt m-tourism in Malaysia.

5 Personal Innovativeness in Information Technology (PIIT)

Chang, Cheng and Lai (2005) refer personal innovativeness (PI) as the degree whether an individual is willing to adopt new innovations. Agarwal and Prasad (1998), subsequently adapted PI in the IT domain and proposed a new measurement namely Personal Innovativeness in Information Technology (PIIT). Citrin et al., (2000) stressed that all individuals possessed a certain degree of innovativeness. The explanation goes that individuals with high level of PIIT are usually risk takes, active seekers of new ideas and are more venturesome since they have higher tolerance level towards uncertainty when compared with individuals with lower PIIT (Rogers, 1995; Liu and Li, 2010). Similarly, Lu, et al., (2008) pointed out that when individuals have higher PIIT, they developed more positive perceptions towards usefulness, complexity and compatibility which then contribute to higher intention to adopt. There are numbers of literatures that supports PIIT as an important construct in the study of IT innovations. Using 470 Spanish mobile telephone users as a sample, Joasquin, Carla and Silvia (2009) found that PIIT has significant influence on the intention to adopt m-shopping in Spain. In another study of five

cities across China, Lu et al., (2008) found that PIIT influence the intention to adopt wireless mobile data services using structural equation modelling. Thus, the following proposition has been formulated:

Proposition 6: PIIT has a significant relationship with the intention to adopt m-tourism in Malaysia.

6 Perceived Enjoyment (PE)

Perceived Enjoyment (PE) is the degree to whether engaging a particular system is perceived to be enjoyable in its own right and is regarded as an intrinsic motivation (Venkatesh, 2000). Enjoyment can come in the form of pictures, background music, commercial flash, animations, when consumers search for a particular products or services using their m-devices (Lu and Su, 2009). When the technology is perceived to be fun, this creates favourable attitude to adopt. PE has been found to be significant with the behavioural intention of various IT studies (Teo and Lim, 1999) such as in the adoption of mobile internet (Liu and Li, 2010), PDA phones (Teng and Lu, 2010) and mobile phones (Chang, 2010). In this context of study, when consumers experience the feeling of fun, joy or playfulness (Webster et al., 1993) attributed to the adoption of m-tourism, this leads to positive emotions (Revels, Tojib and Tsarenko, 2010) and promote the intention acceptance. Thus, the following proposition has been formulated:

Proposition 7: PE has a significant relationship with the intention to adopt m-tourism in Malaysia.

7 Moderating effect: Gender and Age

According to Venkatesh et al., (2003) men are task-oriented in nature and like to focus on problem solving (Gefen and Straub, 1997). Thus this explains why men perceived usefulness more important than women. Women on the other hand are affected by the services and emotional traits and as a result, PEOU are more salient for women (Hu, Said and Hu, 2010; Zhang et al., 2009). In the study of UTAUT, gender was found to moderate the effect of EE, PE, FC and SI (Venkatesh et al., 2003). Furthermore in the study of wireless mobile broadband to access games (Ha Yoon and Choi, 2007) and wireless mobile data system (Lu, Yu, Liu, 2006), findings indicated that gender moderates PE and PIIT respectively. In terms of age, the perception of usefulness on the intention to adopt a particular technology is weaker for older consumers when compared to younger consumers (Venkatesh et al., 2003). The rational goes that young consumers are influenced by extrinsic rewards and in this case the usefulness of using a particular technology (Pan and Maryalice, 2010). In the study of UTAUT2, age was found to moderate FC and hedonic motivation (Venkatesh et al., 2012). Thus, the following proposition has been formulated:

Proposition 8: Gender and age moderates all relationships among variables in the research framework.

IMPLICATIONS

The study provides important implications for researchers, travel related organizations, mobile developers and government agencies rendering m-tourism services for Malaysian consumers. In terms of the theoretical perspective, the conceptual framework extends the UTAUT with two psychological science constructs namely PIIT and PE to examine the consumers' intention to adopt m-tourism. We believe that the extended UTAUT can provide richer insights than UTAUT alone. The study also contributed to the existing literature for emerging markets by taking into perspective of m-tourism which is currently a neglected area among scholars. The study has contributed by providing the foundation on the factors that may influence the adoption of m-tourism and bringing new perspectives beyond the traditional IT studies. In terms of managerial implications, as PE might have positive influence on the intention to adopt m-tourism, travel related organizations and government agencies should focus their marketing campaigns by disseminating information on the benefits of m-tourism. One of the benefits of m-tourism is the ability to purchase anytime and anywhere thus resulting to time saving and convenience among potential consumers who are always on the go. The adoption also helps to enhance shopping effectiveness among consumers. Thus in order to create a favourable PE among consumers the strategy is to highlight on the potential advantages of adopting m-tourism in the marketing campaign. Secondly, given that EE might be an important construct in promoting the intention to adopt m-tourism, mobile developers should stress on the friendly interface of m-websites To begin with, the m-sites should have easy navigation system, straightforward hierarchical menu design and should display only the relevant information to avoid clogging the bandwidth. Yang (2010) suggested that the interface should takes into consideration the phone processing speed, thus two different types of interface designs should be created; one for the high end device and another for low end device. As m-tourism will involve payment transactions, the payment systems should not be complicated. M-sites should reflect the convenience of payment and have straightforward registration process. Additional support should also be made available by travel related organizations. For example by providing frequently asked questions (FAQ), step-by-step video guides and caring customer support. Additionally, mobile developers should ensure that the m-devices are user friendly. M-devices can be enhanced with bigger screen size, input mechanisms, memory, battery life span and screen resolution, thereby helping to craft a positive EE perception among consumers. Thirdly in view that EE may influence PE, travel related organisations should ensure that m-tourism is easy to operate with minimum efforts. A simple strategy is by conducting a road show or supplement training programs to teach consumers on how to operate and navigate m-websites. Fourthly, given that SN may exert an important influence on the intention to adopt, they should not be ignored. As the opinion of relatives, friends, mass-medias and colleagues are important, government agencies and travel related organizations can apply two strategies. The first one is by promoting their advertisements at popular social networking sites such as 'Facebook', 'Twitter', 'MySpace' and 'Friendster' and to take advantage of the word-of-mouth marketing strategy. Consumers who help to spread positive words to others using the social networking sites should be rewarded with free gifts, discounts, vouchers and travel coupons. The second one involves the invitation of opinion leaders or celebrities to provide a review or testimonial on the relevant m-sites. By publishing their testimonials this will encourage adoption among non-users. Sixthly, in view that PIIT might be important in this study, the market should be segregated since different consumers require

different benefits when adopting to a particular technology. For example in order to stimulate non-innovative consumers at the early stage, travel related organizations and government agencies should focus their marketing strategy by giving our gift vouchers, rebates or cash back. The right marketing communications should also be tailored for this group to increase their confidence level of a particular technology. In light that PE might be an important variable in the consumers' intention to adopt m-tourism, mobile developers should integrate the element of fun in their m-sites such as by including animated graphics, icons, music, avatar and other entertainment elements. The positioning strategy should portray the elements of happiness and fun. Hence this will create a favourable shopping experience for consumers as they will view m-tourism as an enjoyable experience. Finally in view of the importance of FC to promote the intention to adopt m-tourism, they should be given equal attention. Practitioners and government agencies should organize training courses and provide adequate supports to facilitate consumers' familiarity in operating m-websites. Additionally, mobile developers can help to reduce the cost of adopting m-tourism by offering rebates, partnership with telecommunication companies and any other monetary incentives.

LIMITATION AND FUTURE STUDIES

The study confronts several limitations. The conceptual framework is based on an extended UTAUT which may not be adequate in predicting consumers' intention to adopt a certain IT. In this paper, we did not include constructs such as government supports, perceived risks, perceived trust and etc which may be considered relevant in improving the explanatory power on the consumer's decision whether to adopt m-tourism. Future studies may draw on these constructs. Finally, while the paper provides useful information to mobile developers, travel related organizations or government agencies, the study is conceptual in nature. Thus, future research can extend the scope of study from the quantitative approach such as by using multivariate analysis.

CONCLUSION

The primary objective of the study is to examine on the intention to adopt m-tourism in Malaysia. In view of the benefits of adopting m-devices and the ever increasing number of m-devices in Malaysia, more consumers are expected to adopt m-devices as another source of purchasing channel. Therefore in order to understand what motivates consumers to shop virtually, a conceptual research framework was developed. Since UTAUT can only explained up to 70 percent of usage intention, additional constructs were integrated. The study decided to extend the framework with two additional psychological constructs namely PITT and PE. The framework contributes to the existing body of knowledge for travel related organizations, mobile developers and government agencies by providing richer insights on the strategy to create a successful marketing campaign from an emerging market viewpoint.

ACKNOWLEDGEMENT

This research is part of the author's PhD work at Asia e University, Kuala Lumpur, Malaysia and was supported by the UTAR Research Fund (UTARRF) grant, under the project number IPSR/RMC/UTARRF/2012-C2/G03

REFERENCES

1. Agarwal, R., and Prasad, J. (1998). "A conceptual and operational definition of personal innovativeness in the domain of information technology", *Information Systems Research*, Vol. 9 No. 2, pp. 204–215.
2. Ahas, R., Aasa, A., Mark, U., Pae, T., and Kull, A. (2007), "Seasonal tourism spaces in Estonia: Case study with mobile positioning data", *Tourism Management,* Vol. 28, pp.898-910.
3. Ajzen, I. (1991), "The theory of planned behavior", *Organisational Behaviour and Human Decision Processes*, Vol. 50, pp. 179-211.
4. B. I. Tan., G. W. H. Tan., and K. B. Ooi. (2011), "King's Biscuits Berhad: Crafting the next move?", *Emerald Emerging Markets Case Studies,* Vol. 1 No.1, pp. 1-4.
5. Bhattacherjee, A. (2000), "Acceptance of Internet applications services: The case of electronic brokerages", *IEEE Transactions on Systems, Man, and Cybernetics* - Part A: Systems and Humans, Vol. 30 No. 4, pp. 411-420.
6. Carlsson, C., Carlsson, J., Hyvonen, K., Puhakainen, J. and Walden, P. (2006). "Adoption of mobile devices/services-Searching for answers with the UTAUT". In Proceedings of the 39th Hawaii international conference on system sciences.
7. Carlsson, C., Walden, P., and Bouwman, H. (2006), "Adoption of 3G+ services in Finland", *Journal of Mobile Communications,* Vol. 4 No.4, pp.369–384.
8. Carolina L.N, Francisco J.M.C and Bouwman, H. (2008), "An assessment of advanced mobile services acceptance: Contributions from TAM and diffusion theory models", *Information & Management* Vol. 45 No. 6, pp. 359–364.
9. Chang, M. K., Cheung, W., adn Lai, V. S. (2005). "Literature derived reference models for the adoption of online shopping", *Information & Management,* Vol. 42 No. 4, pp. 543-559.
10. Chang, P. C. (2010), "Drivers and moderators of consumer behaviour in the multiple use of mobile phones", *International Journal Mobile Communications*, Vol. 8 No. 1, pp. 88–105.
11. Chong, A.Y.L., Darmawan,N., Ooi, K.B., and Lin, B. (2010), "Adoption of 3G services among Malaysian consumers: an empirical analysis", International Journal of Mobile Communications, Vol. 8 No.2,p p.129–149.
12. Chong, A.Y.L., Chan, F.T.S., and Ooi, K.B. (2012), "Predicting consumer decisions to adopt mobile commerce: Cross country empirical examination between China and Malaysia", *Decision Support Systems*, Vol. 53 No.1, pp.34-43.
13. Citrin, A., Sprott, D., Silverman, S., Steven, N. and Stern, D. (2000), "Adoption of internetshopping: the role of consumer innovativeness", *Industrial Management & Data Systems*, Vol. 100 No. 7, pp. 294-300.
14. Davis, F.D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly*, Vol. 13 No. 3, pp.319-340.

15. Fishbein, M., and Ajzen, I. (1975), Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research. Reading, MA: Addison-Wesley.
16. Gefen, D., and Straub, D.W. (1997), "Gender differences in the perception and use of e-mail: an extension to the technology acceptance model, MIS Quarterly, Vol. 21 No. 4, pp. 389–400.
17. Goh, D.H., Ang, R.P., Lee, C.S., and Lee, C.K. (2010), "Determining services for the mobile tourist", *Journal of Computer Information Systems*, Vol. 51 No. 1, pp.31-40.
18. Gupta, B., Dasgupta, S., and Gupta, A. (2008), "Adoption of ICT in a government organization in a developing country: An empirical study", *Journal of Strategic Information Systems*, Vol. 17, No. 1, pp. 140–154.
19. Ha, I., Yoon, Y., and Choi, M. (2007), "Determinants of adoption of mobile games under mobile broadband wireless access environment", *Information & Management*, Vo. 44 No.3, pp. 276-86.
20. Hong, S.J., Thong, J.Y.L., Moon, J.Y., and Tam, K.Y. (2008), "Understanding the behavior of mobile data services consumers". *Information Systems Frontier*, Vo. 10 No. 4, pp.431–445.
21. Joaquin, A.M., Carla, R.M., and Silvia, S.B. (2009). "Exploring individual personality factors as drivers of M-shopping acceptance", *Industrial Management & Data Systems*, Vol. 109, No. 6, pp.739-757.
22. Katz, R., 1980. "Time and work: toward an integrative perspective", in Staw, B.M., Cummings, L.L. (Eds.), Research in Organizational Behavior. JAI Press, Greenwich, CT, pp. 81–127.
23. Kim, D.-Y., Park, J.-K., and Morrison, A. M. (2008). "A model of traveler acceptance of mobile technology", *International Journal of Tourism Research*, Vol. 10 No.5, pp.393-407.
24. Langelund, S. (2007), "Mobile travel", *Tourism and Hospitality Research*, Vol. 7, No ¾, pp. 282–289.
25. Lee, J.K., and Mills, J.E. (2010), "Exploring tourist statisfaction with mobile experience technology", *International Management Review*, Vol. 6 No. 1, pp.91-101.
26. Liu, Y., and Li, H. (2010), "Mobile internet diffusion in China: an empirical study", *Industrial Management & Data Systems*, Vol. 110 No. 3, pp. 309-324.
27. Lu, H.P., and Su. P.Y.J. (2009), "Factors affecting purchase intention on mobile shopping web sites", *Internet Research*, Vol. 19 No. 4, pp. 442-458.
28. Lu, J., Chang, L., Yu, C.S., and Wang, K. (2008), "Determinants of accepting wireless mobile data services in China", *Information & Management*, Vol. 45 No.1, pp. 52-64.
29. Lu, J., Yu, C.S. and Liu, C. (2006). "Gender and Age Differences in Individual Decisions about Wireless Mobile Data Services: A Report from China. China Mobile Value- Added Services Analysis Report", available at http://helsinkimobility.aalto.fi/papers/Mobile%20Services_1_3.pdf (accessed 11, February 2012)
30. Luo, X., Han. L., Zhang, J., and Shim, J.P. (2010), "Examining multi-dimensional trust and multi-faceted risk in initial acceptance of emerging technologies: An empirical study of mobile banking services", *Decision Support Systems,* Vol 49, pp.222-234.
31. Malaysian Communications and Multimedia Commission (MCMC). (2012). Statistical brief number eleven: Hand phone users survey, available at

http://www.skmm.gov.my/skmmgovmy/media/General/pdf/SKMM-HANDPHONE-SURVEY-2011.pdf (accessed 22 April 2013)

32. Nysveen, H., Pedersen, P. E., and Thorbjørnsen, H. (2005), "Intentions to use mobile services: Antecedents and cross-service comparisons", *Journal of the Academy of Marketing Science*, Vol. 33 No. 3, pp. 330-346.
33. Ooi, K.B., Sim, J.J., Yew, K.T., and Lin, B. (2011), "Exploring factors influencing consumers' behavioral intention to adopt broadband in Malaysia", *Computers in Human Behavior*, Vol. 27 No. 3, pp. 1168-1179.
34. Pan, S., and Maryalice, J.M. (2010), "Internet use intention and adoption among Chinese older adults: From the expanded technology acceptance model perspective", Computers in Human Behavior Vo. 26, No. 5, pp.1111–1119.
35. Pesonen, J., and Horster, E. (2012), "Near field communication technology in tourism", *Tourism Management Perspectives,* Vol. 4, pp. 11–18.
36. Rao, S., and Troshani, I. (2007), "A conceptual framework and propositions for the acceptance of mobile services", *Journal of Theoretical and Applied Electronic Commerce Research*, Vol. 2 No. 2, pp. 61-73.
37. Revels, J., Tojib ,D., and Tsarenko,Y. (2010), "Understanding consumer intention to use mobile services", *Australasian Marketing Journal* , Vol. 18 No. 2, pp.74–80.
38. Rogers, E.M. (1995), Diffusion of Innovations, 4th ed., The Free Press, New York, NY.
39. Rogoski, R. R. (2005), "Wireless by design", *Health Management Technology*, Vol. 26, No. 1, pp. 1-7.
40. Shin, D.H. (2010), "Modeling the Interaction of Users and Mobile Payment System: Conceptual Framework", *International Journal of Human-Computer Interaction*, Vol. 26 No. 10, pp. 917-940.
41. Siau, K., Lim, E.P., and Shen, Z. (2001), "Mobile commerce: promises, challenges, and research agenda", *Journal of Database Management*, Vol. 12 No. 3, pp. 4-13
42. Tan, G. W. H., Sim, J.J., Ooi, K.B., and Kongkiti, P. (2012), "Determinants of mobile learning adoption: An empirical analysis", *Journal of Computer Information System*, Vol. 52 No. 3, pp. 82-91.
43. Taylor, S., and Todd, P.A. (1995), "Assessing IT usage: the role of prior experience", *MIS Quarterly*, Vol. 19 No. 2, pp. 561-70.
44. Teng, W.C., and Lu, H.P. (2010), "Consumer adoption of PDA phones in Taiwan, *International Journal Mobile Communications*, Vol. 8 No. 1, pp. 1-20.
45. Teo, T.S.H., and Lim, R.Y.C. (1999), "Intrinsic and extrinsic motivation in Internet usage", *OMEGA: International Journal of management Science*, Vo. 27, pp.25-37.
46. Venkatesh, V. (2000), "Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model", *Information Systems Research*, Vol. 11, pp.342–365.
47. Venkatesh, V. and Davis, F.D. (2000), "A theoretical extension of the technology acceptance model: four longitudinal field studies", *Management Science*, Vol. 46 No. 2, pp. 186-204.
48. Venkatesh, V., Morris, M.G., Davis, G.B., and Davis F.D. (2003), "User acceptance of information technology: toward a unified view", *MIS Quarterly* Vol. 27 No. 3, pp.425–478.
49. Venkatesh, V., Morris, M.G., Davis, G.B., and Davis, F.D. (2003). "User acceptance of information technology: toward a unified view", *MIS Quarterly,* Vol. 27 No. 3, pp.425-478.

50. Venkatesh, V., Thong, J.Y.L., and Xu, X. (2012), "Consumer acceptance and use of information technology: extended the unified theory of acceptance and use of technology", Vol. 36, No. 1, pp.157-178.
51. Webster, J., Trevino, L.K., and Ryan, L. (1993), "The dimensionality and correlates of flow in human-computer interactions", *Computers in Human Behavior*, Vol 9 No.4, pp.411–426.
52. Wei, T.T., Marthandan, G., Chong, A.Y.L., Ooi, K.B. and Arumugam, S. (2009), "What drives Malaysian m-commerce adoption? an empirical analysis", *Industrial Management and Data Systems*, Vol. 109 No. 3, pp.370–388.
53. Wong, C.H., Lee, H.S, Lim, Y.H., Chua, B.H., and Tan, G.W.H. (2012), "Predicting the Consumers' Intention to adopt Mobile-shopping: An Emerging Market Perspective", *International Journal of Network and Mobile Technologies,* Vol. 3 No. 3, pp. 24-39.
54. Yang, K. (2010), "Determinants of US consumer mobile shopping services adoption: implications for designing mobile shopping services", *Journal of Consumer Marketing*, Vol. 27 No. 3, pp. 262–270.
55. Zhang, K.Z.K., Lee, M.K.O., Lee, C.M.K., and Cheung, H.C. (2009), "Understanding the role of gender in bloggers' switching behavior", *Decision Support Systems* Vol. 47 No.4, pp. 540–546.
56. Hu, H.F., Said S.G., and Hu, P.J.H. (2010), "Examining Gender Effects in Technology Acceptance by Arabian Workers: A Survey Study". In 14th Pacific Asia Conference on Information System, Taipei, Taiwan
57. PhoCus Wright. (2013). PhoCusWright's U.S. Mobile Travel Report: Market Sizing an Consumer Trends, available at http://www.phocuswright.com/research_updates/us-mobile-travel-bookings-to-top-us25-billion-by-2014 (accessed 22 April 2013)
58. New Media Tend Watch (2102) available at http://www.newmediatrendwatch.com/world-overview/91-online-travel-market?showall=1 (accessed 22 April 2013)

AUTHOR BIOGRAPHIES

Mr. Garry Tan Wei Han is the Chairperson of the Centre for Business and Management at the Faculty of Business and Finance, Universiti Tunku Abdul Rahman, Malaysia. He obtained his Master of Science in Management from University of Edinburgh, UK, in 2008 and in 2005 a Bachelor degree in Economics (Hons) from University of Malaya, Malaysia. He also holds two insurance diplomas with Honors from LOMA Society, USA. Currently he is also the SiRC visiting scholar at Wee Kim Wee School of Communication and Information, Nanyang Technology University, Singapore.

Dr. Keng-Boon Ooi is the Deputy Vice Chancellor for Research and Development and a Professor of Linton University College, Malaysia. He is also an associate of Singapore Internet Research Centre (SiRC) with Wee Kim Wee School of Communication and Information, Nanyang Technology University, Singapore. He has published over 65 articles in refereed journals.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

SOCIAL NETWORK REACTIONS TO A FLOOD SITUATION

**Panom Gunawong, Faculty of Political Science and Public Administration,
Chiang Mai University, Thailand
Email: panom.gunawong@cmu.ac.th**

**Phatchayathit Jankananon, Faculty of Political Science and Public Administration ,
Chiang Mai University, Thailand**

ABSTRACT

Purpose: *In 2011, Thailand faced its worst flooding of all time. The crucial issue of this disaster is how Thai people responded to the situation. This study traces the reactions to this event from Thai social network users of Twitter and Facebook.*
Design/methodology/approach: *The core data for analysis were tweets from hash tag #Thaiflood and messages posted in Thaiflood Facebook. This study constructed a content analysis platform for collecting data from each selected tweet and post during the period of flooding from September 25, 2012 to October 10, 2012.*
Findings: *The findings principally describe the reaction patterns of posts on Facebook and tweets by twitter. These reactions are presented statistically to provide debt-details in user behavior. They conclude, for example, that on Facebook females (58.4%) are more concerned than males about floods; and on tweeter, messages on flooding were tweeted by only 25.1%, of which many re-tweeted.*
Practical implications: *If possible, government should consider these social networks as a critical tool example in a disaster management plan. This would help in responding immediately to an event, and assist in reducing damage.*
Originality/value: *This study explains interaction between the social network and disaster phenomenon. Furthermore, the results help to provide a fundamental background for the next step of research in this area, such as understanding the phenomenon through the lens of theory.*

Keywords: Social network, Flooding, Disaster management, Thailand

INTRODUCTION

Increasing numbers of social networks are a part of daily life. They help to connect people around the globe via social network applications such as Facebook, Twitter, and MySpace. For instance, Thailand has around 18 million Facebook users (as of April 2013) [I], of which over 12 million are in Bangkok. This ranks Bangkok number one as having the most Facebook users worldwide (as of April 2013) [II]. Social networks have been utilized increasingly by both the public and private sector in order to extend their reach into the general public. For example, hotels in Taiwan employ Facebook as their international e-marketing tool (Hsu, 2012), while the

Chinese government has used Weibo to disseminate information and provide services to its citizens (Liu *et al.*, 2012).

In recent years, the public sector and general public have used social networks to send and receive information during disasters (e.g. Murhpy, 2013; Polen, 2008). Like other countries, Thailand has embarked on using social networks for disaster management. For example, the National Disaster Warning Center uses a website, and in some cases Facebook, and twitter, to inform people about disasters occurring in Thailand and other parts of the world. Therefore, this paper explored social network use during the 2012 flood in Thailand, with the aim to observe how social network users reacted to the event. To this end, Facebook messages and tweets of Thaiflood were examined. Thaiflood was established by a non-government organization, which provided information on floods in Thailand.

RELATED WORK

Social networks such as Facebook and twitter have become important tools for disaster management. They serve as new media for connecting people, who are affected by disaster, and guiding disaster management. Community functions are disrupted generally during a disaster (Abarquez and Murshed, 2004), when the organizations involved can employ social networks in various aspects including disseminating public safety information, sending notifications and emergency warnings, and providing a supplement to a conventional emergency channel for assistance requests (Lindsay, 2011).

As such, various accounts have been reported of Facebook and twitter use for disaster management. Flood information, deriving from government agencies, local councils and new media, was distributed to local residents and travelers via Facebook during the recent 2010/11 Queensland and Victoria floods (Bird *et al.,* 2012). Freeman (2011) examined the use of social networks in the Australian context for providing information during natural disasters. He pointed out the shortcoming of circulating information by traditional methods, i.e. television and radio broadcasts that communicate one-way to citizens, whereas social networks are more dynamic and allow for knowledge sharing. Similarly, Polen (2008) indicated the problem of one-way communication from officials to the general public, as compared to backchannel communication (peer-to-peer communication) using social media that include twitter and personal blog. More advanced use of twitter for disaster management was suggested by Sakaki *et al.* (2010). With the real-time nature of twitter, these researchers could use tweets to predict earthquakes and send notification e-mails to registered users.

According to what is written above, there is still room for investigating the relationship between social media and disaster management. Therefore, this study aimed to explore reaction to the Facebook and Twitter network during a flood situation.

RESEARCH METHODOLOGY

Tweets from hashtag #Thaiflood and messages posted in Thaiflood Facebook were the core data for analysis, collected from September 25 to October 10, 2012. In total, there were 21 Facebook messages and 748 tweets for analysis. The data derived were analyzed by means of content analysis, where the contents of the Facebook messages and tweets were categorized into groups. Statistical analysis was also performed by way of frequency and percentage.

RESULTS AND DISCUSSION

1 Thaiflood Facebook

Overall, 22 messages were posted on the Thaiflood Facebook from September 25 to October 10, 2012 (Table 1). Evidently, the number of messages posted was considerably small both in terms of the number/day, which ranged from zero to three messages/day, and the total number. This clearly indicated a low number of information 'providers' disseminating flood and related information on a relevant Facebook. Nevertheless, the small number of Facebook messages triggered rather wide reactions among Facebook users, who accessed Thaiflood Facebook during the study period. This reaction based on total number of Likes, Comments and Shares, was 8,590, 558, and 2,938, respectively. It was obvious that the number of Likes on the Facebook messages was higher than that of Comments and Shares, because Likes on Facebook are easy to register with just one click.

The results indicate that although there were only 22 posts on Facebook, 12,089 reactions of Likes, Comments and Shares were registered. This also implies that many people see, know, monitor and share information.

Table 1 The Likes, Comments and Shares registered on Thaiflood Facebook messages from September 25 to October 10, 2012

Date	Facebook Message	Number of Likes	Number of Comments	Number of Shares
25 September 2012	Message #1	626	74	477
	Message #2	294	14	140
26 September 2012	Message #1	624	23	39
27 September 2012	Message #1	376	54	97
28 September 2012	Message #1	694	16	174
	Message #2	412	12	65
29 September 2012	Message #1	239	15	53
	Message #2	246	28	114

	Message #3	362	30	126
30 September 2012	-	0	0	0
1 October 2012	Message #1	943	32	389
2 October 2012	Message #1	229	3	196
	Message #2	233	6	81
3 October 2012	Message #1	399	44	205
4 October 2012	Message #1	301	23	116
	Message #2	362	22	105
5 October 2012	Message #1	261	20	80
	Message #2	191	9	48
	Message #3	239	15	84
6 October 2012	Message #1	638	77	212
	Message #2	355	19	72
7 October 2012	-	0	0	0
8 October 2012	-	0	0	0
9 October 2012	-	0	0	0
10 October 2012	Message #1	566	22	65
Total	**22**	**8,590**	**558**	**2,938**

The post observed on October 1, 2012, was used as an illustrative point for analyzing more details. This post was selected, due to it gaining most attention by having 943 Likes. The picture and message from this post showed a new discovery, in that floods had less effect on rice grown on water. It should be noted that information was obtained from only 500 of 943 Facebook users, who clicked on Like, because of the technical limit set by Facebook. It was discovered that of these 500 users, 292 (58.4%) were female, 189 (37.8%) male, and gender of the remaining 19 (3.8%) was not specified (Table 2). This suggests that women were more concerned than men about floods.

Table 2 Likes on Thaiflood Facebook messages by gender

Gender	Number of Facebook users	Percentage
Male	189	37.8
Female	292	58.4
Not specified	19	3.8
Total	**500**	**100**

Contents of the comments posted on Thaiflood Facebook on October 1, 2012, were analyzed. There were 32 comments in total, of which one could not be included for analysis, due to the privacy setup used by the user. From these 31 comments, it was found that men and women posted almost equally; 15 comments made by men and the rest by women (Table 3).

Table 3 Thaiflood Facebook messages by types of comments and gender

Type of Comments	Number of comments	Percentage	Gender	
			Male Number of comments	**Female** Number of comments
Support	23	74.2	8	15
Critique	6	19.4	5	1
Suggestion	1	3.2	1	-
Argument	1	3.2	1	-
Total	**31**	**100**	**15**	**16**

The comments under question can be grouped into four types: support, critique, suggestion and argument. Comments under the support category (23, 74.2%) were positive reactions from Facebook users. Evidently, most comments fell into this group (Table 3). The users posted comments that supported or praised the Facebook messages concerned; for example, one comment read "*Thai people are excellent!*" This may indicate how users supported Facebook messages for carrying useful data to them and other people. Also, the messages may be thought to contain information that was liked or particularly important.

The six comments (19.4%) posted by Facebook users in the critique category expressed their own opinions of the messages concerned, which may or may not support the information provided. For example, one user commented, "*In the next 25 years, [we] will grow crops on water.*" This comment was a reaction to the news on 'floating' rice, which forced him/her to express an opinion on the possibility of 'floating' crops in the next 25 years. The posts and their statistics hint of people having strong positive reactions to new ways of adapting to life with flooding.

The one comment (3.2%) from a Facebook user in the suggestion category provided ideas based on information contained in the messages under question. This user commented, "*This idea should be promoted in rice farming areas, which are also the water retaining areas; it will be very useful.*" It could be said, therefore, that this user suggested carrying out the idea in other areas, which may be of benefit to others. There was also only one comment (3.2%) in the last category; argument, which contradicted other opinions and carried a negative view. This Facebook user stated, "*We can only do rice farming on the other people's back*." 'One does rice farming on the other people's back' is a Thai proverb, which means taking advantage of other people, and this user used it to express his/her opinion of the information on 'floating' rice farming.

As mentioned above, most comments were assigned to the support category (74.2%). However, with gender taken into consideration, a marked contrast was observed, in that almost all comments posted by women fell into this category, while those submitted by men were scattered across all four categories (Table 3).

Concerning Shares of the Thaiflood Facebook messages posted on October 1, 2012, data were obtained from 161 of 389 Facebook users, due to Facebook's technical limit and users' privacy setup. It was observed that of the 161 users, 92 or 57.14% were female (Table 4). This finding is congruent with that of message Likes, which was clicked more by women than men. This may confirm that women were more concerned than men about the flood and more active in disseminating information.

Table 4 Shares of Thaiflood Facebook by gender

Gender	Number of Facebook users	Percentage
Male	63	39.13
Female	92	57.14
Not specified	6	3.73
Total	**161**	**100**

Shares of Thaiflood Facebook messages normally received comment as well, which also was analyzed. As with comments on Facebook messages, comments on Shares also could be categorized into four groups: support, critique, suggestion and argument (Table 5). It can be seen that 55 comments (43.3%) fell into the support category; and, similar to comments on Facebook messages, women provided more of them than men. Interestingly, the number of critique comments was considerably high; accounting for 52 (41.9%), and second only to support comments. The suggestion and argument comments (5 and 12, respectively) were considerably small in number when compared to the other two categories. In any case, Shares of Facebook messages drew more reactions in terms of comments than Facebook messages (cf. Table 3).

Table 5 Comments on Shares of Thaiflood Facebook messages by types of comments and gender

Type of Comments	Number of Comments	Percentage	Gender		
			Male Number of comments	Female Number of comment	Not specified Number of comments
Support	55	44.3	20	31	4
Critique	52	41.9	31	20	1
Suggestion	5	4.1	3	1	1
Argument	12	9.7	4	8	-
Total	**124**	**100**	**58**	**60**	**6**

2 Thaiflood twitter

From September 25 to October 10, 2012, a total of 748 tweets were from the hashtag #Thaiflood (Table 6). It was found that the Thaiflood twitter was most active on September 28, 2012, when there were 85 tweets and least active on October 7, 2012, with only 8 tweets. Regarding the information disseminated, the 748 tweets can be classified into four groups (Table 6), as follows; 1) tweets on a flood situation (188 tweets/25.1%), 2) tweets on news relating to flood (441 tweets/58.9%), 3) tweets making announcements or warnings (96 tweets/12.8%), and 4) tweets on the weather forecast (23 tweets/3.2%).

Table 6 Types of Thaiflood tweets

Date	Type of Tweets				
	Flood Situation/ Tweet	News relating to flood /Tweet	Announcement or Warning/Tweet	Weather Forecast/ Tweet	Total Tweets
25 September 2012	15	19	2	2	**38**
26 September 2012	17	29	14	4	**64**
27 September 2012	24	33	7	2	**66**
28 September 2012	35	33	13	4	**85**
29 September 2012	9	6	2	2	**19**
30 September 2012	8	5	1	0	**14**
1 October 2012	15	39	7	2	**63**
2 October 2012	15	36	10	2	**63**
3 October 2012	9	42	10	2	**63**

Date	Type of Tweets				
	Flood Situation/ Tweet	News relating to flood /Tweet	Announcement or Warning/Tweet	Weather Forecast/ Tweet	Total Tweets
4 October 2012	10	60	11	0	**81**
5 October 2012	5	46	8	0	**59**
6 October 2012	5	8	4	0	**17**
7 October 2012	0	7	1	0	**8**
8 October 2012	7	42	1	1	**51**
9 October 2012	8	25	1	1	**35**
10 October 2012	6	11	4	1	**22**
Total Tweets	**188**	**441**	**96**	**23**	**748**
Percentage	**25.1**	**58.9**	**12.8**	**3.2**	**100**

As tweets may be re-tweeted by users, re-tweets also were considered in the information on Thaiflood tweets. As an example, re-tweet activities on September 25, 2012, are presented in Table 7, where it can be seen that on this particular day, 11 users re-tweeted the Thaiflood tweet. Each of these users had followers ranging from 13 to 1,075; 2,539 in total. As such, after the re-tweet had started, 2,539 more people accessed the Thaiflood tweet.

Table 7 Users who re-tweeted the Thaiflood tweet and their followers (25 September, 2012)

Date	Re-tweeted Users	Followers
25 September 2012	Pomipei	648
	Bend_Ny	81
	pleng_golf	16
	Timmynokoto	17
	Chaitheguru	206
	Manovana	14
	FahCaramel	112
	PLOYozoK4	107
	peemulia_near	13
	AcinarYoko	1,075
	CityRabbit9	250
Total		**2,539**

Although Thailflood tweets on flood seemed relatively small in number (25.1%). when compared to news relating to floods (58.9%), Thaiflood twitter could still be considered as the main tweet provider in the event of flood. During the study period, Thaiflood continually provided flood information via its tweets, of which many were re-tweeted, thus helping to spread information quickly to others. This proved once again the potential value of social networks during a disaster like flood.

CONCLUSION

Thaiflood employed Facebook and twitter for circulating information in the event of flood. These social networks showed a wide reaction among the respective users, which can be observed by Likes, Comments, and Shares on Facebook messages, and re-tweets on Twitter. Thus, in the Thai context, where users of Facebook and twitter continue to rise, social networks can provide new channels of communication to the public over the course of disasters. This insight would be of crucial importance to Thai government agencies concerned with managing disasters, as a social network can become a critical tool in disaster management plans. Using a social network that distributes information quickly would help these agencies to obtain immediate responses in the event of disaster, and accordingly help to reduce the damage and loss caused.

REFERENCES

1. Abarquez, I., and Murshed, Z. (2004), *Field Practitioners' Handbook*, Asian Disaster Preparedness Center, Pathumthani, Thailand.
2. Bird, D., Ling, M., and Haynes, K. (2012), "Flooding Facebook – the use of social media during the Queensland and Victorian floods.", *Australian Journal of Emergency Management*, Vol. 27 No. 1, pp. 27-33.
3. Freeman, M. (2011), "Fire, wind, and water: social networks in natural disasters", *Journal of Cases on Information Technology*, Vol. 13 No. 2, pp. 69-79.
4. Hsu, Y.-L. (2012), "Facbook as international eMarketing strategy of Taiwan hotels", *International Journal of Hospitality Management*, Vol. 31 No.3, pp.972-980.
5. Lindsay, B. R. (2011), "Social media and disasters: current uses, future options, and policy considerations". CRS Report for Congress prepared for Members and Committees of Congress, Congressional Research Service, 6 September 2011. Available at: www.fas.org/sgp/crs/homesec/R41987.pdf
6. Liu, Y., Zhou, Y., and Liu, G. (2012), "*Chinese Government Use of Social Media: A Case of Shanghai Weibo @Shanghaicity.*" in DEST 2012, Proceedings of The 6th IEEE International Conference on Digital Ecosystems and Technologies: Complex Environment Engineering, Campione d'Italia, Italy, 18-20 June 2012.
7. Murphy, M. (2013), "Social Media and the Fire Service", *Fire Technology*, Vol. 49 No 1, pp. 175-183.
8. Polen, L. (2008), "Online social media in crisis events", *Educause Quarterly*, Vol. 31 No. 3, pp. 76-78.
9. Sakaki, T., Okazaki, M., and Matsuo, Y. (2010), "Earthquake Shakes Twitter Users: Real-time Event Detection by Social Sensors" in *WWW 10 Proceedings of the 19th International Conference on World Wide Web*, Raleigh, North Carolina, USA, 26-30 April 2010, pp.851-860.

Note

[I] www.socialbakers.com/facebook-statistics (accessed 19 April 2013)
[II] www.socialbakers.com/facebook-statistics/cities (accessed 19 April 2013)

Authors:
Panom Gunawong* is a lecturer in the Faculty of Political Science and Public Administration at Chiang Mai University, Chiang Mai, Thailand. Dr. Gunawong holds a Ph.D. in Development Policy and Management (Development Informatics) from the University of Manchester, UK. His core areas of focus are e-governance, e-government, ICT4D and failure analysis.

Phatchayathit Jankananon is a student in the Faculty of Political Science and Public Administration at Chiang Mai University, Chiang Mai, Thailand. She is interested in the utilization of ICT in disaster management and public services.

* Corresponding author: Fax +66 53 942988
E-mail address: panom.gunawong@cmu.ac.th (P. Gunawong).
Address: Faculty of Political Science and Public Administration,
Chiang Mai University, Chiang Mai 50200, Thailand

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

"NOVEL SMART MAP" DESIGN FOR THE TOURISM INDUSTRY

Student, Hsin-Jung Lu, Department of Technology and Transportation Management, National Chiao-Tung University, Hsinchu, Taiwan, ROC

**Professor, Lee, Tzong-Ru(Jiun-Shen), Department of Marketing
National Chung-Hsing University, Taichung, Taiwan, ROC**

ABSTRACT

The main function of the NOVEL SMART MAP(NSM) is to assist tourists who come to the Ximending area for sightseeing in Taipei, Taiwan, ROC. With this digitalized map, they can smoothly plan their schedules. The idea of Novel SMART MAP comes from that tourists won't need to spend too much time in searching places to visit in general. The goal of NSM P is to make tourists' use of time visiting local businesses more efficient. There are two characteristics in this modern map: First this map will reduce the probability of tourists wasting time going to a store which is "closed" on the day that they search. If the store is not open, the system will advise tourists to switch to another store with a similar style which is close to the "closed" store. The map provides an available "match" for both restaurant and recreational type businesses. The second advantage of NSM is that the system will tell tourists: when "YOU ARE READY TO GO!" so they do not need to wait in line, for example, to have a table at once in restaurant that they have chosen.

There are two additional functions of this modern map. One is that coupons can be made available for the stores which may not appear by default on the search results of this map, as long as this business is willing to pay for the advertisement service charge. The other additional function is the relevant positions between each spot for the stores are shown in NSM.

Based on the user-friendly and modern-style design of this map, we hope that NSM will attract tourists with that the characteristics and functions of it will bring convenience to those visiting the Ximending area in Taiwan.

INTRODUCTION

As there are many foreigners visiting Taiwan every year, how to make them happy is important. Authors try to put myself in their shoes. If authors were tourists, the more things I can do in one day, the more delight I have. Time saving is a key. NSM can help tourists have a great schedule. In this case, Ximending area is used as example where is noted for heaps of new and odd stuff.

The goal of NSM is to shorten the time of waiting in front of the store (restaurants, nail-decorated shop, cinema etc.) and confusing which way to go. The system can tell you:
˙You complete a feasible match
˙It's time to go!
˙Distance between two places
˙How long you probably have to take

˙The store is “closed” today or not
˙There is another good choice or not
˙Detail of the restaurants and spots

Besides this information, the NSM also appends a full view of Ximending area and numerous coupons by other store owners who want to boost their business.

THEORY AND METHOD

Tourists don’t like to wait and bear too much uncertainty. Just like customers waiting for a restaurant. Waiting time is one of the key satisfaction factors. Customer satisfaction is important because it is usually related to whether customers will repurchase a product (Katz, Larson & Larson, 1991). In the restaurant business, waiting time is an important determinant. Dube, Renaghan, and Miller (1994) claim waiting time will affect customers’ repeat-purchase intention to restaurants. In this case, if customers wait too long for getting seats, they incline not to go to this area for another trip.

In psychological theory, during the waiting period, consumers face uncertainty about how long they have to wait, and experience stress (Bielen & Demoulin, 2007). Some researchers suggest that any information provided during the waiting period can reduce the uncertainty of the wait and lower the level of stress experienced by consumers (Bielen & Demoulin, 2007; Maister, 1985). Moreover, the uncertainty waiting time will influence customers’ emotional responses, and then the customers’ emotional responses will affect their service evaluation to this restaurant (Bielen & Demoulin, 2007).

To eliminate user’s uncertainty, NSM provides enough information (store’s name, address, telephone number, open time, distance, and length of time has to take) and real-time reply as soon as possible. Also the system will update the newest information of existing stores and add some popular tourist attractions, as travelers incline to search for adventure, and novel places which experiences are different from home.(Christine A. Vogt, © 2011 SAGE Publications) NSM system makes use of customer relationship management database to lend users information that is more attractive to them. Just like customization, after you key in personal profile (age, gender, household member, and income), the NSM system will try to offer the map which is suitable for you. In virtue of the fact that people are affected by the environment they are. (Sarah Gardiner, Ceridwyn King, and Debra Grace, © 2012 SAGE Publications)

Customer will be satisfied to have a high quality meal and unforgettable travel. Therefore, tourists are willing to come to Taiwan for another trip and recommend to friends, NSM can also promote tourism industry for countries.

NSM installs GIS system. GIS can help consumers figure out accurate address and location of destination. It helps to compute distance and time that has to take between two spots. Even users don’t know where to go, NSM would advise consumers go to the nearest place by GIS system.

SIMULATION

Miss.A and Mr.B just arrive at Ximending. They don't know how to start their trip, so they ask NSM for advice.

The system will ask user to key in personal profile in order to cater his/her preference.

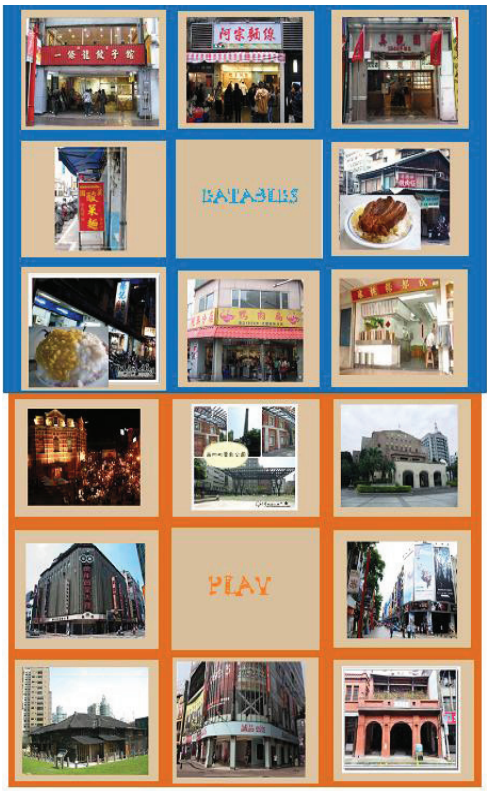


Figure 1

Figure 1 show the main page of NSM system. Users can select one restaurant to have their lunch or dinner on the upper side of the main page, and choose somewhere to play or stroll on the lower side. Then the system will tell you if your mapping is feasible. Miss A wants to eat dumplings, therefore she click the first restaurant.

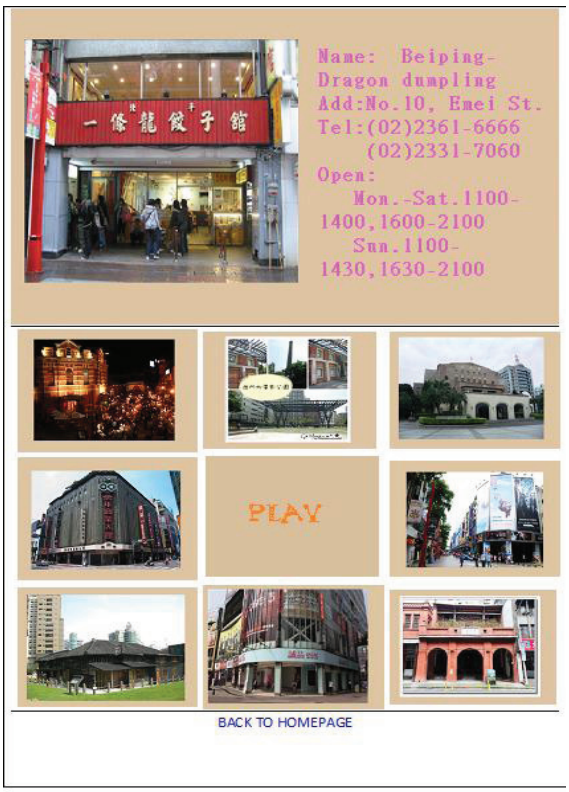


Figure 2

In Figure 2, is the page of “Beiping Dragon Dumpling” restaurant with many choices of interesting scenic spots. Then they can select one beautiful place to have fun. Miss A wants to go shopping. Undoubtedly, she selects the Elite 116 bazaar.

Figure 3

As the match is very well, system will tell you that "Good Mapping!" (Figure3)And NSM will remind you to depart at accurately when the time is suitable. Figure5 shows the outcome. What's more, the system will also show the whole map after you make two targets destinations. The map includes the distance between 2 sites and the distance they have to walk.(Figure4)

Figure 4

Figure 5

The system is not a yes man. If you do a bad match or one of your destination is closed, NSM will pop out this word “switch the order” and “do another choice”. Figure6 show the outcome.

Figure 6

If they don't like the restaurant after seeing the introduction, it's okay to back to home page to get another option. Click the bottom under the pictures (Figure7), and then back to homepage to choose another place to go(Figure8) or change their taste to others cuisine(Figure9).

Figure 7

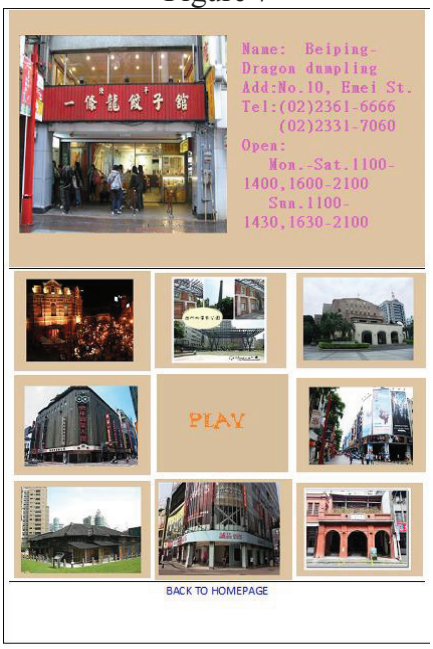


Figure 8

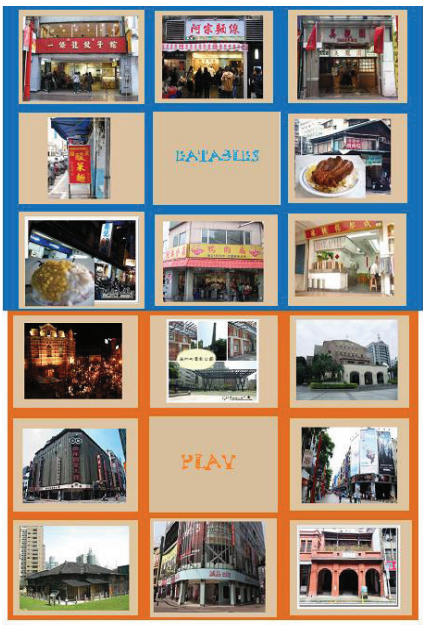


Figure 9

NSM has a full view of Ximending area's map (Figure10). Miss. A and Mr. B don't need to worry about whether they get lost since the map is very clear and simple. Icons on the map are restaurants and resorts which the system advice tourists to visit. (A-G: restaurants; a-g: recreation place)

NSM also provides an additional service that they let others store put their coupons in the system as long as they willing to pay for it. The coupons just like pop ad (kind of advertisement), it will pop out every times after the NSM system changing the page.

With the NSM, Miss. A and Mr. B really have pleasant memory in Ximending area. They decide to go to others area of Taiwan thanks to NSM assistance. Last but not least, NSM system will ask users to fill a feedback form. There are questions such like: "Is the NSM meet your requirement?", "Are you satisfied? ", "Will you come to visit our country by using NSM? ", "Does this system provide convenient service during this trip?", "Are you astonished at NSM system?", etc. All of their personal profile and their choice of destination will be record to CRM, so as to analysis people behavior and improve NSM system.

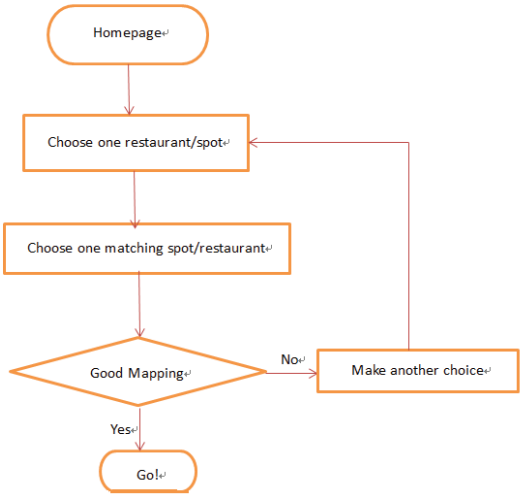
EXTENSION

˙NSM system can apply to any other tourist attractions like Brighton, Okinawa .Etc. This system now focus on the region which is not large. Distance between spots is reachable on foot and by public transportation.

˙Over time, NSM system will become more mature and stronger. NSM can accommodate larger database, so it can use on bigger cities. In the future, you can key in what you want to eat/see/buy, and then NSM start to find out your need and plan your schedule. Or put into your budget cost, and NSM helps you plan the schedule.

SUMMARY

The goal of inventing NSM is to assist tourists and backpacker. With NSM system, scheduling journey is not a problem anymore. NSM can solve all the complicated parts in few seconds to make the trip more feasible. The following flow chart shows how it works:



NSM can reduce the possibility that consumers arrive at a store which is not open. Raising the efficiency can bring more satisfaction to customer, and more satisfaction can boost the tourism industry as they will come to visit our country again. NSM plays an important role in a travel industry. It can bring enormous benefit to tourists and local business.

REFERENCE

1. Pin-Chieh Wang and Shiang-Lih Chen McCain, School of Hospitality Management, Widener University “How the group composition influences customers’ expectation of the waiting time in the restaurant setting”
2. Christine A. Vogt(2011). “Customer Relationship Management in Tourism: Management Needs and Research Applications.” Journal of Travel Research.
3. Sarah Gardiner, Ceridwyn King, and Debra Grace(2012). “Travel Decision Making: An Empirical Examination of Generational Values, Attitudes, and Intentions.” Journal of Travel Research.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

PERSONALITY TRAITS AND PROFESSIONAL RESPONSIBILITY – PRELIMINARY MODEL

Radosław Mącik, Maria Curie-Skłodowska University, Faculty of Economics, Lublin, Poland, Pl. M.C. Skłodowskiej 5, 20-031 Lublin, Poland
E-mail: radoslaw.macik@umcs.lublin.pl

Dorota Mącik, University of Finance and Management in Warsaw, Faculty of Psychology, Warsaw, Poland, ul. Pawia 55, 01-030 Warszawa
E-mail: dorota_macik@tlen.pl

Radosław Mącik holds Ph.D. in Economics from Maria Curie-Skłodowska University in Lublin, Poland – Faculty of Economics. His research interests are focused on consumer and organizational behavior, particularly on ICT adoption influence on such behavior, as well as on quantitative and qualitative marketing research methods, including online research.
Dorota Mącik holds Ph.D. in Psychology from John Paul II Catholic University in Lublin, Poland – Faculty of Social Science. Her current work on University of Finance and Management in Warsaw, Faculty of Psychology, Warsaw is focused on personality factors influence on coping with stress in ordinary situations compared to a situation of life-threatening or extreme health-related risks, and also in organizational settings.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

PERSONALITY TRAITS AND PROFESSIONAL RESPONSIBILITY – PRELIMINARY MODEL

Radosław Mącik, Maria Curie-Skłodowska University, Faculty of Economics, Lublin, Poland, Pl. M.C. Skłodowskiej 5, 20-031 Lublin, Poland
E-mail: radoslaw.macik@umcs.lublin.pl

Dorota Mącik, University of Finance and Management in Warsaw, Faculty of Psychology, Warsaw, Poland, ul. Pawia 55, 01-030 Warszawa
E-mail: dorota_macik@tlen.pl

ABSTRACT

Purpose: *Purpose of this paper is analysis of connections between personality traits and effective functioning on different levels of professional responsibility. The main aim of this study was building a model which could explain in what way personality moderates coping with responsibility stress.*
Methodology: *Two research questions were stated: What personality traits distinguish managers from other groups with personal responsibility of decision (with higher and lower level of responsibility); and: What stable personality and emotional control traits can predict effective professional functioning on different required levels of personal responsibility decision? Three groups of people (N=110), with different level of responsibility were exam: managers – characterised by middle level of personal responsibility, Air Traffic Controllers (ATC) – very high level of personal responsibility and representatives of different occupations with low level. Two questionnaires were used: to measure personality traits (Neo-Pi-R, Costa&McCrae) and emotional control (ECQ Brzezinski).*
Findings: *Comparing of analysed groups shows many significant differences in four of the five big dimensions and specific traits. So, it is possibly to say, that probably only special types of persons can be effective as manager, like as ATC. Also, two path models were estimated. Initial model was poorly fitting the data, but the second one is characterized by very good fit indices. It shows, that some personality traits effect responsibility level directly, and in the highest way - Values. Excitability in general has negative influence on responsibility level.*
Value/oryginality: *The main originality of this paper is comparing managers with ATC group as a specific kind of responsibility. This approach make possible to state conclusions about real role of special personality traits to be effective in coping with stress responsibility.*

Keywords: professional responsibility, personality traits , managers, air-trafic controllers, organizational psychology
Classification: research article

PURPOSE OF THE STUDY

The purpose of this paper is to analyse the connections between selected personality traits and the effective functioning on different levels of professional responsibility.

Management, nowadays, is very difficult. Enterprises functioning in rapidly changing environments require managers to be a special kind of person with the aim of effective coping with challenges.

We can distinguish some specific conditions that make management difficult.

First of all, there are conditions related to global situations. Globalization processes make even quite small firms (SMEs) similar to MNEs, especially during decision processes (Berger *et al.,* 2012, Shimizu *et al.,* 2012), while external conditions change very fast. On the other hand, at a time of global crisis, necessary decisions can be unpopular sometimes, especially for employees, causing managers meeting with many negative emotions which they have to cope with (Mazzei and Ravazzani 2011, Ricard *et al.*, 2012, Metz *at al.* 2012, : Zagelmeyer and Gollan 2012).

The second thing is the expansion of ICT. As a result, managers have more information; and the information, even from other countries, is coming immediately. It is difficult to assimilate and process so many pieces of information; to try to select the important pieces and then make the best decisions for the company (Rei, 2004; Girard, 2005; Rajabzadeh *et al.,* 2012, Tao and Min, 2011, Carlevale 2011).

The third thing is the relationships with a large group of people. In many cases, these relationships have only a business nature, but some of them are not satisfied (due to type of person/personality or, for example, the subject of negotiation). It is also a reason of stress present in a manager's life.

The last thing is the level of personal responsibility taken for a decision. Every manager takes their own, personal responsibility for the effects of a decision they have made. The level of responsibility is related to the level of competence, but being even very competent employee is not enough to effective functioning as manager (Holmlund-Rytkönen and Strandvik 2005). This situation is caused by personality traits, which are very important in understanding a manager's functioning, such as consciousness, openness or possibilities to control emotions (Markowić, 2008; Service nad Carson 2010; Dragoni, 2011).

However, a manager's level of responsibility, especially in small and medium firms, although quite high, is not very high. So it is interesting to see, what personality structure characterises the people who must cope with a very high level of responsibility. It was decided that Air Traffic Controllers (ATC) can be a good control group for managers. The level of responsibility among ATCs is very high, because in the case of a mistake or a wrong decision, there is a real risk of an air crash and human death (Metzger and Parasuraman, 2005).

METHODOLOGY

Among many different factors, which are related to effective management, we can distinguish personality traits. It is known, that they are important, because managers finally take full responsibility for their decision and cope with decision's stress in a way which is characteristic for them. External conditions, quick changes and even technologies and possibilities of getting more information, make the deciding process more stressful. On the other hand, this process must be rather quick, as a response to an actual situation. Managers try to cope with this stress and decision responsibility in a different way and with a different level of effectiveness. The aim of the presented research was an attempt to find specific traits, which allowed managers to be effective in coping with responsibility stress.

Two research questions were stated:

RQ1. What personality traits distinguish managers from other groups with personal responsibility of decision (with higher and lower level of responsibility)? And, as a specific detail: How much personality profiles differ in groups?
RQ2. In what way stable personality and emotional control traits can predict effective professional functioning on different required levels of personal responsibility decision?

To find the answers:

It was decided to examine three groups of people (N=110), which differ in the level of responsibility. The main group was managers – characterised by a middle level of personal responsibility (n=60), and two control groups: one of them was Air Traffic Controllers (ATC) –a very high level of personal responsibility (n=25), and the last – representatives of different occupations (DO) with a low level of responsibility (n=25). Subjects were qualified to participation in that study, by students Agnieszka Trybuś and Magdalena Bogacka-Neugebauer, who also administered tests to the subjects and coded data. Authors want to thank them for their support in this study.

To find personality traits we has decided to use the Costa and McCrae approach, which is well known as the Big Five model, because of its relative stability of traits and, additionally, the possibilities to make cross-culture comparisons. The Neo-Pi-R questionnaire by Costa & McCrae in the Polish adaptation was used to measure personality structure. To examine one's possibilities to control emotions, a short scale was used, which measures internal predispositions to cope with emotional states. This scale was constructed in Poland by Brzeziński, and the basic theory lies among biological approaches.

Statistical analyses were made by using the IBM SPSS 21 statistic programme.

FINDINGS

1. Differences in personality structure

The first step to find answers to the research questions was comparing the personality traits among the three groups.

The first analysed trait was Neuroticism. This personality factor shows emotional stability and susceptibility to experiencing negative emotions.

Tab. 1. Differences between groups in *ANOVA* statistics for Neuroticism trait

	ANOVA		Managers n = 60		ATC n = 25		Others n = 25		Managers – ATCs	Managers - others
Personality Trait	F	*p*	M	SD	M	SD	M	SD	*Post-hoc p*	*Post-hoc p*
Neuroticism	10,486	,000	4,67	2,09	2,84	1,77	5,32	2,12	**,001**	,369
Anxiety	18,515	,000	5,18	2,05	2,68	1,75	5,44	1,47	**,000**	,833
Angry hostility	10,366	,000	4,95	1,57	3,44	2,12	5,60	1,76	**,008**	,306
Depression	7,561	,001	5,10	2,67	2,96	1,99	5,28	2,48	**,001**	,950
Self-consciousness	1,821	,167	5,08	2,28	4,52	1,83	5,64	1,75	,491	,500
Impulsiveness	1,308	,275	6,77	1,93	6,08	2,68	6,16	1,80	,357	,446
Vulnerability	10,922	,000	4,13	1,91	2,76	1,64	5,28	2,15	**,009**	**,035**

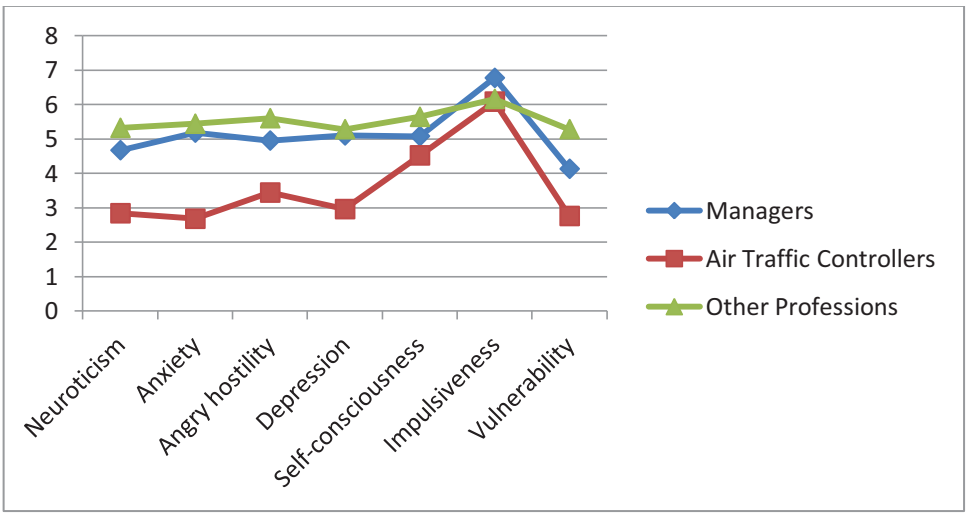


Figure 1. Profiles of Neuroticism in analysed groups

As it is shown in Table 1 and Figure 1 managers are more similar to people with low level of responsibility than to ATCs. High responsibility level requires skills of controlling negative emotions, such as anxiety, anger, irritation, sense of helplessness or guilt. It is also related to a low level of vulnerability, which means the ability to coping with stress effectively with no negative feelings. On the other hand, the level of Impulsiveness (interpreted as being able to control sudden desires of doing something) is quite high in all the groups. It shows that irrespectively of the responsibility level, people need to do something for themselves to reduce stress. This analysis suggests, that in stressful management conditions – related to a higher responsibility – managers should be more similar to ATCs.

The next trait is Extroversion. It is important in effective management because of the necessity of relationships. The profiles of analysed groups are shown in Figure 2.

A manager is a person who should have good relations with subordinates, other managers and people from enterprise's environment with the aim of effective managing. The results of this study confirm, that managers are a group with the highest level of global extroversion. They are friendly people, with a large number of social contacts. At the same time, however, they are assertive, dominative with a tendency to leadership. These traits allow them to be independent in decision making; it is similar in ATCs' profile.

Tab. 2. Differences between groups in *ANOVA* statistics for Extraversion trait

	ANOVA		Managers n = 60		ATC n = 25		Others n = 25		Managers – ATCs	Managers – others
Personality Trait	F	*p*	M	SD	M	SD	M	SD	*Post-hoc p*	*Post-hoc p*
Extraversion	7,586	,001	6,85	2,39	5,60	2,45	4,88	1,62	**,056**	**,001**
Warmth	2,21	,109	5,63	2,35	5,68	2,50	4,48	2,49	,996	,115
Gregariousness	,652	,523	6,12	2,35	5,48	2,80	5,88	1,79	,685	,942
Assertiveness	4,014	,021	6,68	1,88	6,68	2,21	5,36	2,27	1,000	**,021**
Activity	8,506	,000	6,75	1,92	5,36	1,98	5,00	2,25	**,012**	**,001**
Excitement-seeking	7,589	,001	6,73	1,92	5,24	1,74	5,40	2,00	**,004**	**,011**
Positive emotions	3,523	,033	6,72	2,30	6,44	2,43	5,28	2,09	,867	**,026**

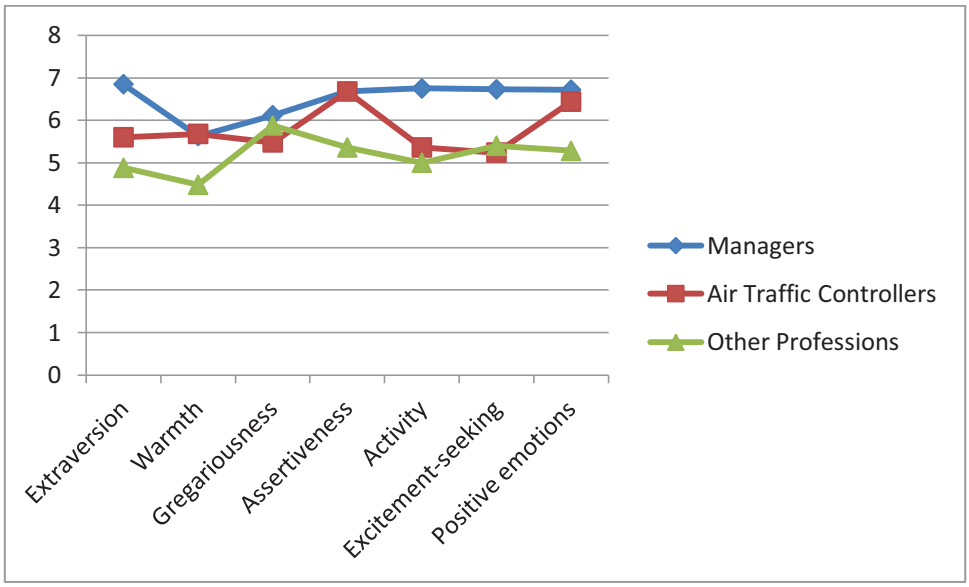


Figure 2. Profiles of Extraversion in analysed groups

But, in contrast to ATCs, not very high responsibility level allows them to be more active (e.g. work under time pressure) and risky. Rapid enterprise changes of the environment sometimes require risky decisions, which are not expected from ATCs. However, a lower level of the Excitement-seeking trait could be an impediment in effective management.

The third analysed personality trait was Openness to experience, for this dimension almost all means (for three groups) are lying above an average level (typically assumed as score between 4th and 6th sten), which suggests that decision making – in a broad sense – requires curiosity, tolerance and a special kind of unconventional thinking.

Tab. 3. Differences between groups in *ANOVA* statistics for Openness trait

	ANOVA		Managers n = 60		ATC n = 25		Others n = 25		Managers – ATCs	Managers – others
Personality Trait	F	*p*	M	SD	M	SD	M	SD	*Post-hoc p*	*Post-hoc p*
Openness	3,800	,025	7,43	1,82	7,68	2,34	6,32	1,73	,853	**,044**
Fantasy	,936	,395	7,05	2,32	7,36	1,93	6,52	2,18	,826	,574
Aesthetics	,336	,715	5,70	1,84	5,72	2,97	6,12	2,20	1,000	,786
Feelings	4,903	,009	7,33	1,92	6,20	2,60	5,92	2,18	**,073**	**,018**
Actions	1,583	,210	7,05	2,47	6,76	2,22	6,12	1,24	,934	***,069***
Ideas	4,682	,011	6,98	1,80	7,88	2,54	6,16	1,80	,145	,195
Values	19,818	,000	7,72	1,57	9,00	1,26	6,08	2,10	**,001**	**,004**

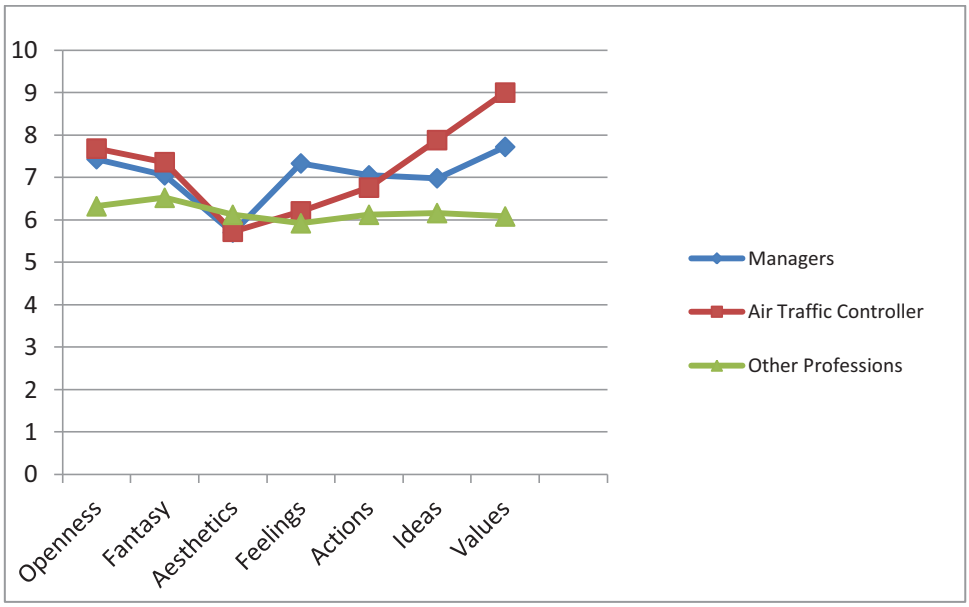


Figure 3. Profiles of Openness in analysed groups

A low responsibility level (in other professions group) is related to a relatively lower openness to experience in all of its factors, and almost all factors have similar averages. With increasing of responsibility profiles come more varied. Managers are similar to ATCs in general Openness trait and in Fantasy, Aesthetic and Action factors. Fantasy is probably important for an anticipation of possible consequences of decisions and makes the managers able of strategy planning. Managers, like ATCs, are also open to seek new possibilities, skills and chances to be better at decision making. Managers have a higher level of feelings, which suggests that they can recognize emotions (both themselves and other people's) and probably use them in management. People of other professions cannot do it well, and ATCs must not follow emotions. A significant difference is also observed between ATCs and managers in Values factor. Managers are less open to values than ATCs, but more than people of other professions. ATCs' high result is probably caused by responsibility for peoples' safety and life. management sometimes requires reinterpreting of constant values (e.g. about HR policy or environmental protection), so an effective manager should be open to new ideas, values or trends to take the most appropriate solution.

The forth analysed personality trait was Agreeableness. It shows the way of interpersonal functioning, positive or negative relationships and tendency to be dependent / independent from others.

Tab. 4. Differences between groups in *ANOVA* statistics for Agreeableness trait

	ANOVA		Managers n = 60		ATC n = 25		Others n = 25		Managers – ATCs	Managers – others
Personality Trait	F	*p*	M	SD	M	SD	M	SD	*Post-hoc p*	*Post-hoc p*
Agreeableness	2,240	,111	4,80	1,96	5,64	2,08	4,44	2,38	,214	,750
Trust	8,281	,000	5,60	2,32	6,96	2,79	4,12	2,47	*,058*	**,035**
Straightforwardness	3,379	,038	5,03	2,41	6,28	1,95	4,76	2,28	*,062*	,870
Altruism	2,976	,055	6,15	2,17	5,84	2,15	4,84	2,56	,833	**,043**
Compliance	6,170	,003	4,83	1,59	6,44	1,80	5,40	2,66	**,001**	,689
Modesty	,126	,882	5,12	2,35	5,00	2,36	4,84	2,29	,976	,873
Tender-mindedness	3,161	,046	4,90	1,94	3,80	2,36	5,12	2,07	*,070*	,896

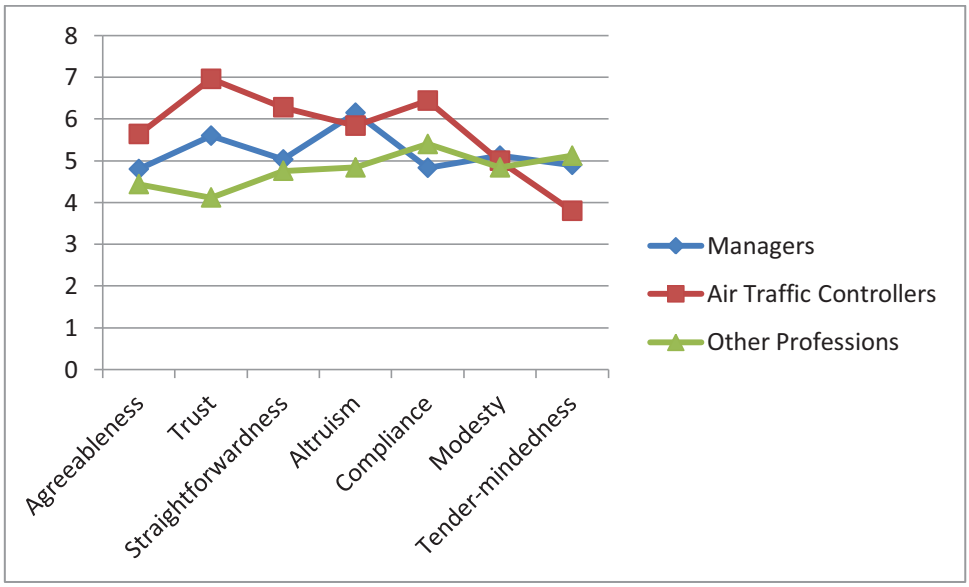


Figure 4. Profiles of Agreeableness in analysed groups

A high responsibility (represented by Air Traffic Controllers) is related to a higher level of agreeableness. ATCs are more straightforward and believe in other peoples' honesty. But, it is worth to note that their work needs such attitudes (e.g. trust towards airplane pilots or cooperate controller). Managers and other professions work in conditions with a lower responsibility, and they also know that nowadays an absolute trust towards everyone can bring negative consequences. ATCs are more able than managers to control angry and aggressive behaviour during interpersonal conflicts, while managers seem to be more dominative and rivalrous. Responsibility is also related to a low tenderness. Feelings or sympathy should not be related to work or decision making due to a possibility of negative consequences. It seems that among managers the level of Tender-mindedness could be lower (now it is the same like other of professions with low responsibility), especially when environment conditions require non-popular decisions.

The last personality trait which was analysed was Conscientiousness. This dimension characterises level of behaviour organizing, motivation to work to goals achieving, tendency to keeping order and beliefs about own competency.

Tab. 5. Differences between groups in *ANOVA* statistics for Conscientiousness trait

	ANOVA		Managers n = 60		ATC n = 25		Others n = 25		Managers – ATCs	Managers – others
Personality Trait	F	*p*	M	SD	M	SD	M	SD	*Post-hoc p*	*Post-hoc p*
Conscientiousness	7,131	,001	6,32	2,27	7,08	2,60	4,72	1,95	,342	**,011**
Competence	21,541	,000	7,15	1,63	8,52	2,08	4,96	2,44	**,011**	**,000**
Order	3,153	,047	6,85	2,43	6,40	2,66	5,40	2,14	,717	**,036**
Dutifulness	5,623	,005	6,17	2,19	7,04	2,57	4,88	2,28	,252	*,053*
Achievement striving	2,442	,092	6,23	2,48	6,64	2,41	5,20	2,27	,760	,176
Self-discipline	4,819	,010	6,00	2,50	7,16	2,70	5,00	2,08	,123	,208
Deliberation	1,034	,359	5,57	2,08	6,12	2,33	6,16	1,82	,507	,458

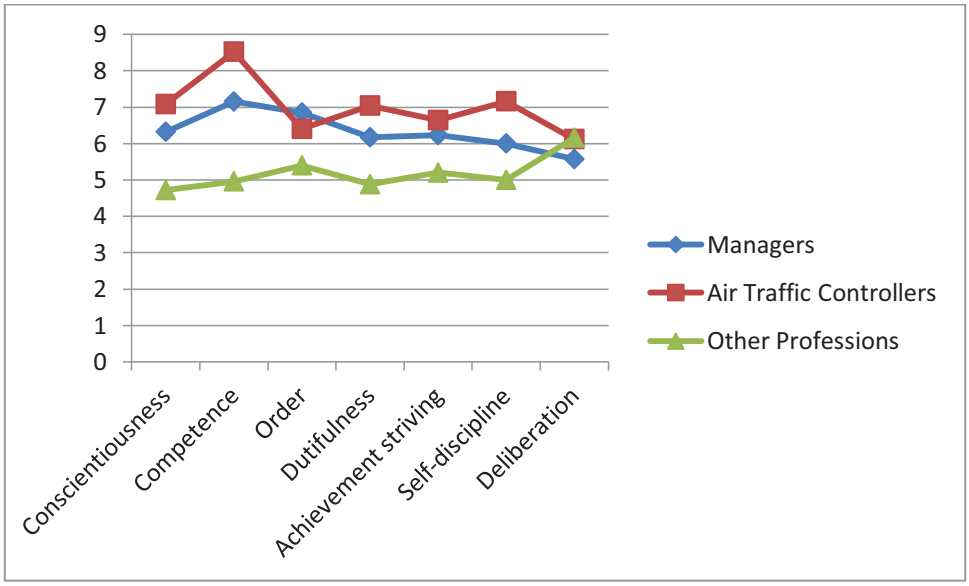


Figure 5. Profiles of Conscientiousness in analysed groups

Conscientiousness differs in the three groups, too.
People of different professions (with a low level of responsibility) have the lowest level of conscientiousness in all factors (excluding Deliberation). The highest responsibility (ATCs) is related to the highest level of the analysed personality trait. The most characteristic factor is Competence, which is the belief about one's possibility to cope with difficult situation. AT Controllers think about themselves as reasonable and effective people, whose decisions are

appropriate to situations. Managers have a bit lower level of Competence comparing to ATCs, but higher than other professions (the difference is significant in both comparisons).

The profiles of ATC and Manager groups are quite similar, and higher than profiles of other professions. It suggests than decision responsibility is related to Conscientiousness dimension.

2. Differences in emotional control dimension.

A special dimension of personality is emotional control. Differences between the analysed groups were found in emotional control: F=50,70, p=.000 for global emotional control possibility. In four of the five components the *p* is lower than .007, and only in one component – Situational control ANOVA is not significant.

Tab. 6. Differences between groups in *ANOVA* statistics for emotional control factors

	ANOVA		Managers n = 60		ATC n = 25		Others n = 25		Managers – ATCs	Managers – others
Emotional control factors	F	*p*	M	SD	M	SD	M	SD	*Post-hoc p*	*Post-hoc p*
Expression control	5,223	,007	50,32	11,16	56,56	7,42	47,32	10,78	**,036**	,453
Emotional - rational motivation	8,939	,000	48,90	10,46	58,44	10,27	53,92	7,04	**,000**	*,083*
Emotional resilience	6,128	,003	55.32	10,77	62,40	6,63	53,04	11,23	**,001**	,772
Situational control	1,069	,347	49,40	11,53	45,76	8,97	49,40	11,25	,346	1,000
Emotional excitability	11,633	,000	45,50	9,55	37,04	9,09	49,84	10,38	**,001**	,146
Emotional control	50,709	,000	52,75	10,33	71,76	6,12	67,76	8,41	**,000**	**,000**

A high responsibility level is related to good emotional control. ATCs are people who have skills to control their emotional expression in physical signs of them, like shaking hands, body movements, laughing or crying. They are also able to control their behaviour during an emotional arousal (both positive and negative). Decisions which they make have rational motives, irrespective of emotions. Managers seems to be more impulsive in their behaviour. Decisions made under the influence of emotions are significantly more emotionally motivated; even low responsibility in other professions is related to a higher level of rational motivating behaviour (statistical tendency).

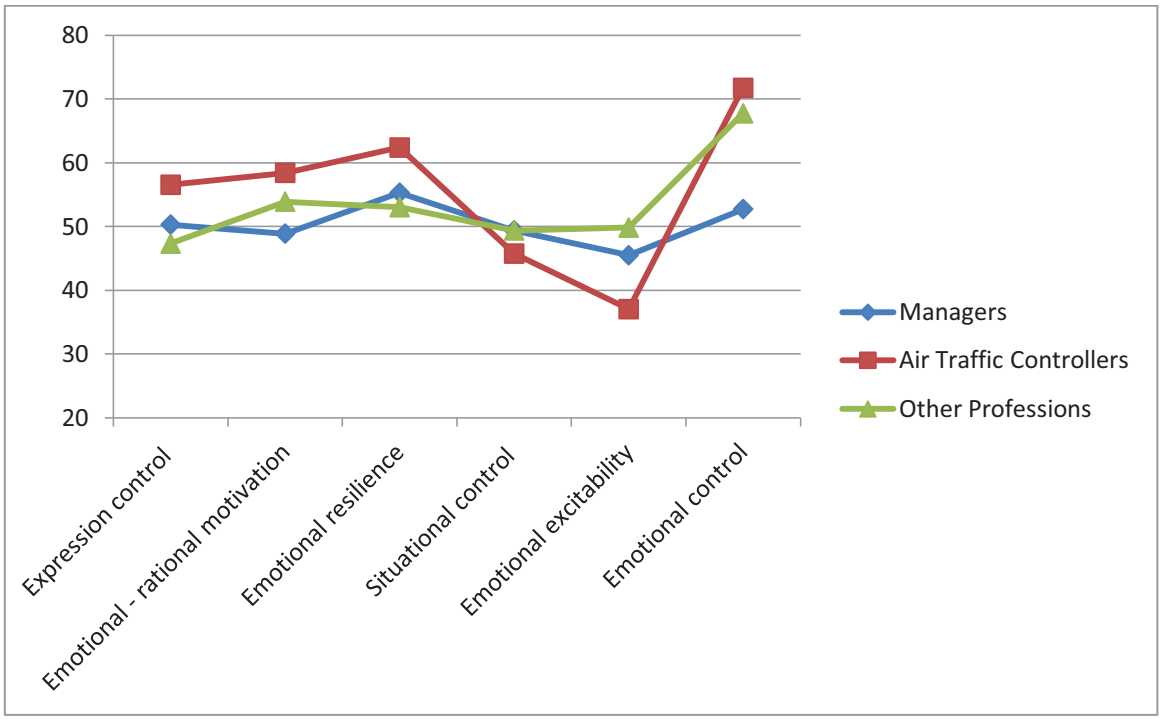


Figure 6 Profiles of Emotional control in analysed groups

A level of Emotional resilience (understood as possibility to act under pressure) among managers is similar to a low responsibility group. It suggests that ability to work without disorganising is more difficult for managers compared to ATCs.
Emotional excitability is also related to responsibility. With increasing responsibility, the level of emotional arousal decreases. This means, that people who have emotional resistance and whose emotional excitability threshold is high – have a possibility to achieve managerial positions. In case of ATCs only such candidates are choosen during recruitment process.
Situational control does not differ groups. Management is generally a situation in which the possibility to control situations, even these with emotional context, is rather small. The way of interpreting these situations is similar for the three groups; the anxiety component is not very high, so coping strategies may occur as often as avoidance behaviours.
Summarising these results we can say, that managers have a significantly lower level of emotional control than ATCs, and they are similar to people with a low responsibility (no significant difference). It means that natural selection in career progression does not provide emotional stability for a manager.

3. Path models explaining responsibility level fit to personality traits

The next aim which was taken was to find traits which can predict the effective functioning on different levels of responsibility. Two path models were estimated.

The first one (Model 1 – Figure 7) was built on the basis of the earlier profile analysis. In this model a set of personality traits (from Big Five subdimensions) explains directly or indirectly (through an emotional – rational motivation or emotional excitability) the responsibility level. This model is poor in terms of fit (Table 7), although it allows us to predict a rather large proportion of responsibility level (about 43%) using its explanatory variables. A closer look at this model shows that the influence of the emotional – rational motivation of the responsibility level is not significant. This led to an improved Model 2 (Figure 8), for which

emotional – rational motivation and its direct explanatory variables were taken out. Therefore, Model 2 is simplified - it includes 5 personality subdimensions instead of 7, and only one additional construct – emotional excitability. Fit of Model 2 is substantially improved compared to Model 1, and is characterized by very good fit indices (Table 7).

In Model 2 five independent variables are correlated. Anxiety has positive correlations with angry hostility and feelings, and negative ones with assertiveness and values. The highest path coefficient is for anxiety and angry hostility: ,43 which means a moderate but significant relationship. Other people's correlation indicators are low, with a clear but rather small relationship.

As it is shown in a model, some personality traits effect responsibility level directly, these are: anxiety, angry hostility, and values. Values and angry hostility are also related to emotional excitability and effect responsibility in an indirect way. Assertiveness and feelings have no direct influence on responsibility level and effect it indirectly by an emotional excitability.

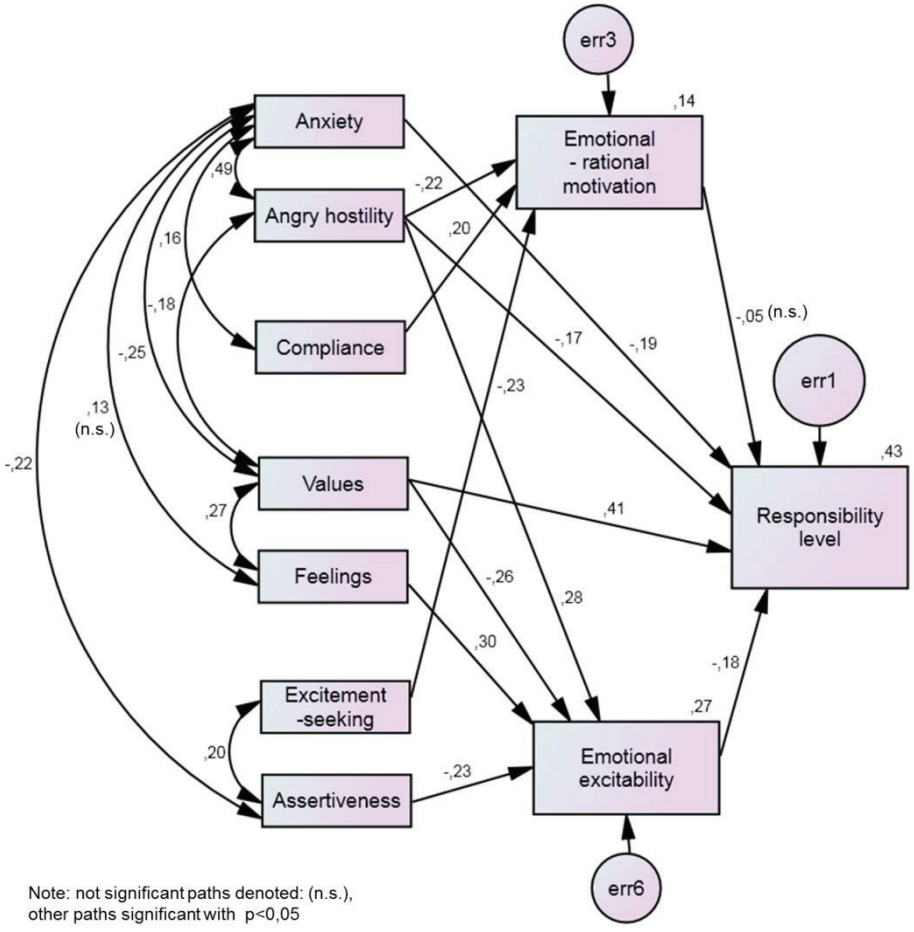


Figure 7 Structure and estimation results of path Model 1

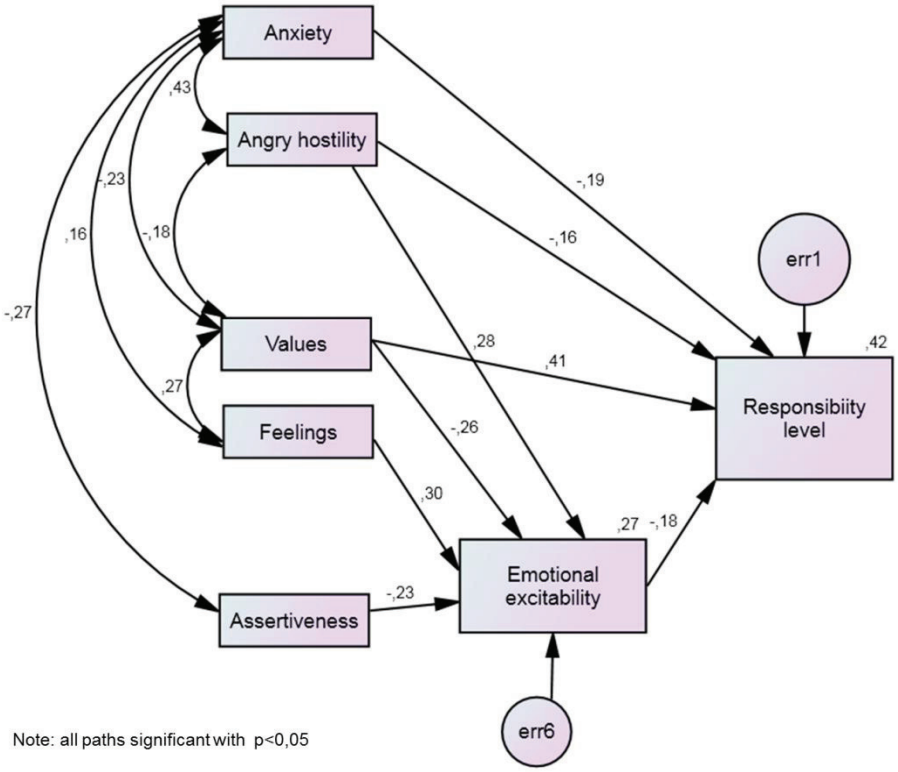


Figure 8 Structure and estimation results of path Model 2

The highest standardised path coefficient is for Values. This trait is understood as tolerance, but from other hand - openness and readiness to discuss different values or seeking other, even not quite accepted solutions. At the same time openness to values and new solutions and being tolerant can decrease emotions when faced with new situations, so emotional excitability level became lower. This two traits can make one's more responsible.

Anxiety is the only one personality trait which effects responsibility level directly in a negative direction. Anxiety persons (even without anxiety disorder) are nervous, full of tension, with a tendency to worry. General anxiety, which is a characteristic for people with high level of this trait, is not appropriate for high responsibly management positions.
Angry hostility with a tendency to experience and react with anger, irritation or hostile attitudes to others makes it difficult to clearly evaluate environmental and human conditions, so management becomes less effective.

Excitability trait is also affected by feelings, angry hostility and assertiveness. Feelings are understood as a sensitivity to one's emotions, which are experienced deeper and in a more differentiated way. A low feelings level suggests that emotional states are less intensive and are only of a little importance. Angry hostility means a tendency to react with anger, frustration and embitterment and these feelings are intensive. An increase of angry hostility is related to the increase in excitability level. The last trait which affects excitability is assertiveness, and its influence is negative. It means that assertive people – being dominative, authoritative and often natural group leaders – do not experience intensive emotions, especially negative, that they cannot control. These four traits explain 27% of an emotional excitability variation. Emotional excitability – in general – has a negative influence on a

responsibility level, which means that easier coming into emotional states (higher results in this scale) is related to poorer responsibility.
Generally, anxiety, angry hostility and values, and also emotional excitability (affected by angry hostility, values, feelings and assertiveness) explain 42% of responsibility variation. This model is fitting the data very well, and is characterized by very good fit indices.

Tab. 7 Estimated models fit measure comparisons

	Measures	Model 1	Model 2
Variance explained	Responsibility level	,433	,417
	Emotional excitability	,273	,274
	Emotional – rational motivation	,142	N/A
Measures of fit	*Chi-square*/*df* (below 2 or 3 better)[a]	2,734	1,147
	p (not significant better)[b]	,000	,330
	GFI (above ,9 is good fit)	,905	,980
	AGFI (above ,8 is good fit)	,791	,920
	NFI (above ,9 good fit)	,734	,951
	RMSEA (,05 or less better)	,126	,037
	PCLOSE (not significant better)[c]	,001	,509
	HOELTER (,05)[d]	61	191
	Conclusion about model fit	*Not acceptable*	*Good fit*

[a] "rules of the thumb" suggested by Carmines and McIver (1981) or Byrne (1989).
[b] for larger samples is often unreasonable to have significant *p*, see Jöreskog (1969).
[c] "p value" for testing the null hypothesis that the population RMSEA is no greater than ,05 indicating close fit - Browne and Cudeck (1993).
[d] Hoelter's (1983) critical N to accept model at significance level of ,05 (with given chi-square statistic and degrees of freedom)

PRACTICAL IMPLICATIONS AND RESEARCH ORIGINALITY

The main originality of this paper is comparing managers with the ATC group as a specific kind of responsibility. This approach makes it possible to state conclusions about real role of special personality traits to be effective in coping with stress coming from responsibility. ATCs are chosen from candidates during long and formal recruitment process, in which personality traits and emotional control are assessed. So it is clearly said what kind of people (understood as a kind of personality) could be working effectively with a very high level of responsibility.

Managers must cope with a quite high responsibility, too, but they became managers in a natural way of career progression, usually no special recruitment procedures were taken. Managers' responsibility for enterprise is higher than responsibility for daily life in the case of other professions, but not as high as for people's life as in the case of ATCs. So it was interesting to check if there are any differences, and, if so (as it was supposed), in which traits managers differ significantly or are similar to ATCs.

Results show that in every analysed dimension there are significant differences in specific traits. It clearly suggests the existence of special structure of personality, which describes each group. So, it is possible to say that only special types of people can be effective managers (such as ATC), because these specific personality qualities are helpful to cope with special decision stress.

An estimated path model is good to predict what personality factors are related to a higher responsibility. So this model can be good as starting point to develop special tool (a scale, a questionnaire or e.g. a structuralised interview) in the aim to check if the person could be effective in coping with a high responsibility.

Nowadays, management is very difficult. We can distinguish specific conditions related to global situation, expansion of ICT , relations with a large group of people and level of personal responsibility for decision. Enterprises functioning in these continuously changing environmental conditions requires from managers to be a special kind of person in the aim to cope effectively with challenges. As a results of the presented study (both path model and profile differences) it is possible to develop methods to find people that tend to become managers, who could be more responsible in their decisions and the probability of making wrong decisions by them could be lower. The comparison of managers with the special group of ATC (which is of a special value for this study) clearly shows what kind of people are managers, and what personality traits should have lower or higher level to be more similar to ATC, especially in traits important in management. These traits can be different depending on the enterprise's size, profile, localization, actual aims and conditions. This is the reason that authors would not list on the specific needed factors and their level. But for every future manager in every kind of enterprise it is possible to make a specific tool to select the person who is most appropriate to the actual enterprise's needs.

REFERENCES

2. Berger, R. , *et.al.* (2011). „Responsible Leadership for Multinational Enterprises in Bottom of Pyramid Countries: The Knowledge of Local Managers, *Journal of Business Ethics,* Vol. 101 No. 4, pp. 553-561.
3. Browne M.W. and Cudeck R. (1993). "Alternative ways of assessing model fit", In Bollen K.A. and Long J.S. [Eds.], "Testing structural equation models", Newbury Park, CA: Sage, pp. 136-162.
4. Byrne B.M. (1989). "A primer of LISREL: Basic applications and programming for confirmatory factor analytic models", New York: Springer-Verlag.
5. Carlevale, E.A. (2001). "Exploring the influence of information overload on middle management decision-making in organizations", *Dissertation Abstracts International Section A: Humanities and Social Sciences*, Vol. 72 (2-A).
6. Carmines E.G. and McIver J.P. (1981). "Analyzing models with unobserved variables". In Bohrnstedt G.W. and Borgatta E.F. [Eds.], "Social Measurement: Current Issues", Beverly Hills: Sage.
7. Dragoni, L.O, *et al.* (2011). "Developing executive leaders: The relative contribution of cognitive ability, personality, and the accumulation of work experience in predicting strategic thinking competency", *Personnel Psychology*, Vol . 64, No. 4, pp. 829-864.
8. Girard, J.P. (2005). "Combating Information Anxiety: A Management Responsibility", *Management of Organizations: Systematic Research*. No. 35, pp. 65-80.

9. Hoelter, J.W. (1983). The analysis of covariance structures: Goodness-of-fit indices. *Sociological Methods and Research*, Vol. 11, pp. 325-344.
10. Holmlund-Rytkönen, M., and Strandvik, T. (2005). "Stress in business relationships", *Journal of Business & Industrial Marketing*, Vol. 20, No. 1, pp. 12-22.
11. Jöreskog K.G. (1969). "A general approach to confirmatory maximum likelihood factor analysis, *Psychometrika*, vol. 34, pp. 183-202.
12. Marković, M.R. (2008). "Managing the organizational change and culture in the age of globalization". *Journal of Business Economics & Management*, Vol. 9, No. 1, pp.3-11.
13. Mazzei , A., and Ravazzani, S. (2011). „ Manager-employee communication during a crisis: the missing link", *Corporate Communications: An International Journal*, Vol. 16 No. 3, pp. 243-254.
14. Metz, I. *at al.* (2012). „Changes in psychological contracts during the global financial crisis: the manager's perspective", *International Journal of Human Resource Management*, Vol. 23, No. 20, pp. 4359-4379
15. Metzger, U., and Parasuraman, R. (2005). „Automation in Future Air Traffic Management: Effects of Decision Aid Reliability on Controller Performance and Mental Workload", *Human Factors*, Vol. 47, No. 1, pp. 35-49.
16. Rajabzadeh, A., *et al.*(2011). "Informational Overload; Roots and Consequences, *Australian Journal of Basic & Applied Sciences*, Vol. 5, No. 12, pp. 353-359
17. Rei, C.M. (2004). "Causal evidence on the "productivity paradox" and implications for managers, *International Journal of Productivity & Performance Management*, Vol. 53, No. 2, pp. 129-142
18. Ricard, A., *et al.* (2012). „International Comparison of Global Perceptions, *International Business Research*, Vol. 5, No. 7, pp. 28-37.
19. Service, R.W., and Carson, C.M. (2010). " Becoming a more effective manager: Reality versus hype",. *China-USA Business Review*, Vol. 9, No. 11, pp. 35-49.
20. Shimizu, T., *et.al.* (2012). "Project managers for risk management: case for Japan", *Benchmarking: An International Journal*, Vol. 19, No. 4/5, pp. 532-547
21. Tao, L., and Min, L. (2011). "An Investigation and Analysis of Information Overload in Manager's Work" *, I-Business*. Vol. 3 No. 1, pp. 49-52.
22. Zagelmeyer, S., and Gollan, P.J. (2012). "Exploring terra incognita: preliminary reflections on the impact of the global financial crisis upon human resource management", *International Journal of Human Resource Management*, Vol. 23, No. 16, pp. 3287-3294.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE HIDDEN CULTURAL MANAGEMENT FACTORS IN ENGLISH CRAM SCHOOLS

Shao-hua Chang, Department of Applied English, Southern Taiwan University of Science and Technology, Taiwan
Email: shaohua@mail.stust.edu.tw

ABSTRACT

Cram schools are a huge business in Taiwan, with parents willing to pay thousands of dollars for what they consider an essential service for their children's academic achievement, especially English cram schools. They are especially intense around inner-city schools. However, it is not easy for English cram schools to be successful under the intense competitive environment. Thus, this study would like to investigate the successful management factors of non-chain or non- Franchisee English cram schools by using the categories in Kwok's Three-layered Cultural Model of Tutorial Schools (Kwok, 2001). Each category of this model represents the need of tutees and their parents. However, it is impossible to fulfill all of the customers' requirements. This study also intends to know the priorities of the management factors of the participant cram schools. If a cram school is to remain competitive, service quality and increasing customer satisfaction are crucial.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

ADEQUATE TEMPERATURE AND HUMIDITY FOR BOOKS AND PEOPLE IN A LIBRARY

Bang-Lee Chang, Chinese Culture University, Taiwan
Email: blchang@sce.pccu.edu.tw

Hui-chen Lee, Chinese Culture University, Taiwan
Email: h3371843@yahoo.com.tw

Yen-Ku Kuo, Chinese Culture University, Taiwan
Email: ykkuo@sce.pccu.edu.tw

Ying-Yueh Su, Chinese Culture University, Taiwan
Email: yysu@sce.pccu.edu.tw

Ching-Tzu Chen, Chinese Culture University, Taiwan
Email: cctju@faculty.pccu.edu.tw

ASTRACT

Taiwan is located in a subtropical zone where there is a lot of moisture during the rainy season or typhoons. In other words, for most of the year, warm and moist climate are two typical features of Taiwan's environment. This kind of climatic conditions (warm temperature and high humidity) create a suitable environment for the growing of bacteria, germ, mold and insects. Besides destroying books, data files stored on electronic support and paper, it also has a serious impact on human health.
The experimental and statistical analyses of the results of this study show that factors such as the total number of people in a library, library floor area, time of day and floor position within the building, have not been showing causality with the bacterial colony count (CFU/m3).

In fact, the subsistence and reproduction of bacteria, germ, mold and insects, has a relation to temperature independent from its relation to humidity in the library environment. This study suggests that the library's administrative staff should set and control optimum temperature and humidity scrupulously. This would not only improve the staff work efficiency but also maintain paper, books and electronic material in appropriate condition. According to the results of this research, the bacterial colony count (CFU/m3) presents an increasing trend when rising the temperature in the library; furthermore, the bacterial colony count decreases as the humidity level increases. However, when both temperature and humidity are considered at the same time, then the relationship to the bacterial colony count (CFU/m3) has no significance (p value> 0.05). The optimum indoor temperature range for the library is 20°C ~26°C and the optimum range of relative humidity is 40%~60% RH.

GENESIS AND THE PURPOSE

Taiwan is located in the subtropical zone, can get plentiful moisture by rainy season or typhoon. Therefore form and "moist climate environment" and "make warm". According to the documents and materials [1] learn: In the past 100 years (1897- 1997), Average temperature of Taiwan and average relative humidity, differentiate 23 ℃and 80% RH. Moreover in the past 10 years according to Central Weather Bureau (2002- 2011) Its statistical data [2] is learnt: The average temperature of this island of Taiwan and range of average relative humidity, is 22- 23℃ and 77- 79 RH respectively. Temperature and humidity since the past one hundred years of Taiwan in other words, there is no obvious change. Relevant literature point out this kind of temperature is moderate, the climatic conditions of the high humidity, quite suitable for the existence of all kinds of bacteria and multiply [1]. Moreover can learn, suspend the respiratory system that the particle will injure the human body in the air with the documents and materials; One is smaller than 5.7 m and suspend the particle pollutant directly, it is apt to initiate breathing problems such as chronic rhinitis, bronchitis, asthma, pneumonia, etc.. Under suspending the surface of particle and absorbing the sulfur dioxide situation, the injury to the human respiratory system will be faster and serious [3]. Angry glue of living beings (Bioaerosols), in order to suspend one kind of particles, including: Suspend the microorganism in the air (such as virus, bacterium, fungi, mould) And small particle (such as spore, pollen, biological toxin) comes out by little organism release [4,5,6]. These tiny microorganism or small particle can enter the human body via the respiratory tracts as stated above, and then it is healthy to influence the people [7, 8].

Learn, the people exceed 80% in the internal environment activity time of room according to the documents and materials [9, 10, 11]. Lance [12] also proposed the similar investigation result in 1996, studied and pointed out: General people account for 87.2% of time of total life in the time of internal environment of room, the time of another about 7.2% is used in the traffic, about 5.6% are the time of outdoor sports finally. The gradual progress and industrial and commercial activity grow vigorously, can predict the people will stay and increase in indoor time continuously in the future with era. The mankind needs it by breathing to maintain the life, so the people, to "closely bound up indoor air quality" (Indoor Air Quality, IAQ) Pay attention to more and more. But, from before state it can learn, Taiwan helps to climate the environments it survives and multiply all kinds of microorganisms. So no matter oneself is the harmful to human body angry glue of living beings polluted, the muzzle enters building room directly or with personnel, mechanical ventilation facilities situation of entering room indirectly by making, certainly will can hardly be avoided.

How to improve indoor air quality, it is the people, building staff member and relevant units of government in fact, important subject that must be faced scrupulously. And the library is the place where the people often call on. Understand the angry glue of living beings which influences people's health, exist in the state of the library, find out the indoor factor influencing colony thickness of the library, and propose taking precautions against or improving the countermeasure, and then improve the indoor air quality of the library. Except that can ensure using the people to be healthy in the library, offer it outside the comfortable activity space; Can reach and increase working efficiency it with keeping many projects such as the books or file in the hall properly by improving the indoor surrounding air quality of the library.

Originally study as probing into the factor with different floors, period, place property, area of floor, the number of people of use and projects such as the warm humidity, etc. in the hall separately, and with the "impacted taking a sample device" (Buck, Bio-Culture B30120), Collect library living beings angry glue sample in the air, strike at culture medium that suit directly sample, and then received the indoor colony thickness of the library. Learn influence the main factor of the colony thickness to include with the experimental result and statistical analysis materials: Indoor relative humidity, temperature and place use properties. Enter factors such as the total number of person, area of floor period and height of floor of the hall, etc. have not been showing causality with the colony thickness.

RETROSPECT OF LITERATURE

1 The angry glue of living beings takes a sample in the way

To different uses or all kinds of buildings of ' air quality ' (including living beings angry glue distribution situation) ,Quite a lot of research has discussed with the plan extensively already; Also have periodical thesis coming up to a large number, put forward the penetrating opinion and valuable research results [13-43]. Various research results, conclusion and suggestion, the improvement of the air quality of all kinds of place, contribute tall and erectly. This research is summed up and gathered together whole and internationally, experts and scholars who probe into this topic can learn after ever using the research approach, probe into the indoor air quality methods internationally, is mostly probed into by the literature and reviewed beginning, and after putting in order and analyzing relevant materials, with the experiment tactics immediately, collected the angry glue sample of living beings in the air, select the ' culture medium ' suitable for use and train samples. Calculate the angry glue quantity of living beings in culture medium with the microscope afterwards; calculate the angry glue thickness of living beings of 1 m^3 air. Collect method of sample at the experiment, roughly can divide into two, until Shen lower law (CFU / ware) naturally first, In order to strike the law (CFU/ m^3) the second kind.

Because the angry glue of living beings is not distributed in the space of room evenly, it will change to distribute the state as the air current is changed in time or space. So gather some figure in the position, sample of the angry glue of living beings, time of taking a sample, train the way, sampling method and computing technology, will all influence the accuracy [13] of the experimental result. Getting relevant with "Shen lower the law naturally" the two differences:

1. Strike the law: Use and strike the law taking a sample device, it is relatively high to catch the angry glue probability of living beings, comparatively accurate at the time of quantitative analysis. But need special instrument, and take a sample the area is relatively small, time is relatively short that take a sample. Moreover need consider the accuracy of the taking a sample device in addition. For example apparatus correct the issue and maintenance question [13], etc.
2. Shen lowers the law: Generally speaking, Shen fall living beings angry glue total number that law obtain than bump into law to be large naturally. But small living beings angry glue among air, easy to bully, flow, influence more unstable, so unable to control the angry glue of living beings effectively Shen drops to surface of culture medium. Lower the quantity and relate to suspend particle size in angry glue Shenyang of living beings. Learn by experiment Shen fall quantity and microbial particle thickness of air

appears positive correlation. Than bump into law to be loud error to lower law Shen take a sample repeatedly. But Shen lower law take special instrument, easy and simple to handle, take a sample area to be relatively loud. Until "bump into law", quantity examine the result, the trend is identical [13] generally speaking "Shen lower law naturally".

2 Indoor air quality

Because of the angry glue thickness of living beings, is the good and bad important assessment indicator or not of the air quality. And the daily colony thickness of angry glue thickness of living beings is come to weigh. The colony in the air is the taller in thickness, show that there is pathogenic microorganism (such as the bacterium, fungi, virus), small the particle (Such as fungi spore, actinomycetes spore). and the dust). It is the higher, the apteral to initiate respiratory disease to wait for the quantity of the common allergic source. Learn [13] according to the literature, influence the factor of the colony thickness in the indoor air, include: Occupy the indoor personnel's density, building and ventilate the situation, day lighting, temperature, humidity, dust content of taking a breath, suspend the diameter size of particle and surrounding environment state etc. Foreign relevant research group, propose the following important conclusions and propose according to the research results:

1. Indoor colony thickness, the winter that summer exceed; Early exceeding noon late; The building exceeds the one-storey house; Exceed the room in the public place, the fire coal gets warm one gets warm in the family more than air conditioner, the dirty air exceeds and cleans the air [13] (China's Mainland).
2. Indoor colony thickness <1,500 CFU/m^3, belong to the room of the hygiene with "ordinary" state; Indoor colony thickness <2,500 CFU/m^3, belong to the room of the hygiene with ' slightly bad ' state. The patient of waiting room gathers and the quantity is large, in order to ensure clinic people to be healthy, the colony thickness <1,000 CFU/m^3 in the fixed air and should be sterilized regularly. Stipulate the colony thickness of office building and hotel <1,500 CFU/m^3 [13] (China's Mainland).
3. The colony thickness of the hospital <1,500 CFU/m^3, places such as hostel, market, club, theatre, amusement park, subway station, etc. Colony thickness <4,000 CFU/ m^3, the colony thickness in the ordinary hotel, hostel air <2,500 CFU/ m^3, GB/T18883-2002 indoor air quality standard, stipulate the colony thickness is 2,500 CFU/ m3 (China's Mainland) [13].
4. Belong to "clean air" colony suggestion of thickness until (bump into law take a sample). Belong to "ordinary air" colony suggestion of thickness until (bump into law take a sample) [13].
5. Indoor colony thickness <1,000 CFU/m^3 is an indoor air quality minimum exigency, the condition of the indoor air with good quality is the indoor colony thickness <500CFU/m^3 (Hong Kong) [14].
6. The indoor colony thickness in summer ≥ 2,500 CFU/m^3 is regarded as the air (the Soviet Union) polluted [13].

Should protect people to be healthy, as well as for really feasible regulation, China's Mainland and Japan, stipulate the suggestion value of the colony thickness in the indoor air tentatively, as shown in Table 1 [13].

Table 1 the air colony thickness advising value (Mainland China and Japan)

The air cleans degree		Sample method	
		Lower the law in Shenyang naturally (CFU / ware)	Strike the law (CFU/ m^3)
		total number of the colony	
Mainland China	Clean air	≤30	≤1500
	Ordinary air	≤75	≤2500
Japan	Very Clean air	1～2	-
	Clean air	≤30	-
	Ordinary air	31～75	-
	Demarcation line	150	-
	slight pollution	≤300	-
	serious pollution	≥300	-

3 The hurting mould with the insect pest of paper books file [1]

Deposits in books files such as the literature periodical, file file, historical materials, the magazine prevails and consult the books in the library, etc., mostly paper materials, and paper material is mostly organic fibrous quality materials, then the moisture when will absorb the air results in hydrolyzing and reacting but enable the fibrous degradation. So, the paper material is extremely apt to suffer water damage. Secondly, the paper makes up and contains the mould and carries on the necessary nutrient of metabolism course in materials. Moreover the temperature of Taiwan is suitable, the climatic conditions that many rain is moist are quite suitable for the microorganism (mould) Grow and breed, make the paper books file must be faced ' mouldly and rottenly ' with the question, learnt, save the place, the mould that is often found in the paper quality material by the literature, including: Aspergillu, Penicillium, Trichoderma, Chaetomum, Cladosporium, Fusarium and other such as Mucor, Rhizopus, Stemphylium, Stachybotrys, Alternaria , Often on books place of file of storing (such as library). The bacterium appearing, it is suitable for the warm humidity of growing, as shown in Table 2.

Generally speaking, humidity exceed saturation or have liquid environmental terms, the bacterium could grow and breed; Take yeast as an example, the environment that the yeast grows, its humidity is close to the saturation; Secondly the mould utilizes long hypha, expand and obtain moisture range. Therefore when the relative humidity is higher than 70%, the mould can grow well. In view of the above, the mould becomes the main bacterium in “mould and rotten microorganism”.

Temperature is from 5℃to can all find bacteria under 60℃ 70℃environment. The most suitable for the temperature range of growth and lie between at 30℃- 35℃ The growth temperature of the mould about 25℃ Moreover fungus reproduction or growth still relates to environmental pH, take mould and yeast as an example, suitable for growing under the environment of pH 2 - pH 8, but relatively have a partiality for the acid environment, the most suitable acid soda value is pH 5. And bacterium like fortunately neutral or lean towards soda grow under the environment, most suitable sour soda value pH 7.5 slightly relatively.
Learn, cause the “mould and rotten” microorganism making the paper material with rotten degradation with the literature, including the fungi, bacterium and radiating the fungus. Paper a material (such as books and file, etc.). It happen “mould and rotten”, “change color” or “go

bad" should possess by primary condition of three pieces, include: Microorganism exist on room of the internal environment, supply with the nutrient that the microorganism needs (food), suitable and environmental (Temperature, humidity, pH, etc.). So long as destroy any condition into it, can prevent the occurrence of paper books file "mould and rotten". Generally speaking, prevent the occurrence of paper books file the "mould and rotten" include [1]:

1. Isolate the microorganism from books file, prevent happening "mould and rotten".
2. Control environment warm, humidity properly, prevent the mould from growing.
3. Control the warm humidity strictly: Temperature, under 20℃, relative humidity: under 65%.
4. Use physical technology or chemical method (Medicine is dealt with), eliminate the mould.
5. Use oxidant, reducing agent, and the superficial mould spot or corrupt mark of removing the paper quality by way of rinsing.

Save the warm humidity [1] suitable for the mould and grow in the place with material of paper quality of Table 2.

Table 2 suitable for the mould and grow in the place with material of paper quality [1]

genus	species	Suitable for the Temperature and humidity that the mould grows	
		Temperature（℃）	Relative humidity（%）
Aspergillus： temperature：middle humidity：85%, dry live type: 65%	Aspergillus flavus Link	30℃～38℃	80%～86%
	Aspergillus niger var.niger	35℃～37℃ Some over 50℃	80%～88%
Penicillium： temperature：low, under 0℃ Can still endanger the parasite humidity：80%～88%	Penicillium citrinum Thom	25℃～30℃ Some over 37℃	80%～85%
	Penicillium chrysogenum Thom	20℃～25℃ Some lower than -4℃	82%～84%
Trichoderma	Trichoderma viride Pers. ex Gray	Middle temperature	88%
Chaetomum	Chaetomum globosum Kunze	25℃～30℃	90%
Cladosporium		18℃～28℃ Some lower than -7℃ Some over 30℃～32 ℃	88%～94%
Fusarium		4℃～32℃	80 %～100 %

But can't grow up only in order to prevent bacteria or mould, require the paper books file to store the place simply (such as the library) Has adopted the low humidity, because it is apt to make the paper shrink to cross the low humidity, even because the too dry brittle rupture. So propose that should set up the central air system in places such as the stacks, etc., use to regulate the temperature and humidity. Can use the window (case) also for fear of factor of short of moseying, etc. The type air conditioner matches and uses the dehumidifier, reach and keep the permanent wet environment of constant temperature. When it is unable to set up the

air conditioning, storing the place must keep the good ventilation state. Usually suitable temperature: It is 24.4℃-27.7℃ in summer, it is 21.1℃ in winter; Humidity: It is 40%- 70% RH in summer, it is 20- 50% RH [44] in winter.

Except that the microorganism causes danger to the books file in the library, the material also in order to destroy the paper quality of insect is saved to the important members in the place. Pointed out by the literature, even if the insect can enter paper quality materials and save the playground smoothly, want to form the party in groups, must offer its growth and environmental condition bred suitably, just have an opportunity to cause serious danger. And it is suitable for the environment of surviving, except the food (such as books). Outside, the warm humidity is also a key factor. Exceed 25℃ as temperature, most insect can grow and multiply fast, look on as temperature lie between at 15℃- 20℃, will slow down the pace bred; It will influence insect's development [45] at 10℃ that it is low. As for insect's demand for the humidity, will be different to some extent with kind of the insect, some insects need high humidity environment (Clothing fish), but some insects can obtain the necessary moisture from the food directly (Wooden termite of the universe). Learnt by the literature, relative humidity 60%- 80% are suitable for insect's reproduction. As temperature is higher than 25℃, the relative humidity is greater than 70%, as to most insects, will breed and grow fast; As regards humidity, the demand for each kind of insect is not the same. But whole but speech, reduce humidity can reduce [45] probability that insect pest take place.

Therefore can know, the basic principle is low temperature, low humidity to prevent the insect from being of endangering the books and file. But stand in the books keeping, general people and on staff member's position in the hall, besides considering keeping security, should give consideration to personnel's comfortableness. So temperature and the two of humidity can't be too low. The books file is kept the comfortable degree of security and personnel should make the equilibrium. Generally propose temperature is set up at 21±1℃, the humidity must accord with property and state of the paper material, and give and adjust (metal historical relic appropriately: Under 45%; Organic material historical relic: 50%-60%). Should moreover prevent from warmly, the humidity changes by a wide margin, some phenomenon not even of preventing the occurrence of warm, humidity, and use to reduce the situation of damaging books file and take place. Because some humidity apt to multiply microorganism or mould too high, attract edible insect of mould, for example clothing fish, book louse, etc. enter the paper books file and store the place, gnaw the books or file [46].

The fleas are a complete metamorphosis insect, have ovum, larva and pupa and adult are four growth periods. Begin to lay eggs in 1-4 days behind the female flea sucks the blood, the ovum is produced in host's nest (in the nest) and in the nearby floor chink; some fleas can lay eggs in host's hair. The flea ovum development relates to temperature, humidity and adult, a nutritional status, suitable for the temperature of laying egging is above 70% for 18℃- 27℃, humidity; 35℃- 38℃ high temperature will inhibit flea's ovum development, will also limit the flea ovum development [47] to pass low temperature seemly.

According to the literature, Dermatophagoides pteronyssinus like life to make warm (20℃-30℃), (Relative humidity 60%- 80%) in dark environment. Mankind feel comfortable environment (Temperature 25℃, relative humidity 75%). Similarly, it is the Dermatophagoides pteronyssinus optimum condition of existence too. Regard locating in

subtropical Taiwan as example, will it be will it be the beginning and winter autumn late summer for irritation, asthma kind to take place season. Is the literature pointed out, the dust in the environment? The main reason [48] it is the good hair. Does another research point out the dust? With the mankind or animal (cat and dog), scurf, hair coming off support the family; Suitable for temperature of growth its 22℃-26℃, relative humidity 70%- 80%. And about 15℃-30℃ of average temperature in Taiwan room, about 60%-85% of relative humidity on average, so, does the climate environment of Taiwan benefit the Dermatophagoides pteronyssinus growth. Cause the dust? Become one of Taiwanese children's important anaphylactogens [49]. This phenomenon can be verified with the detection data that the municipal health bureau of Taipei will release in 2008. Measure and point out in the data: Do the first grade primary school pupils' anaphylactogens mostly come from "Dermatophagoides pteronyssinus" account for 90.8% [50].

4 Suitable for the warm humidity of the life of human house

Learn, most suitable for the temperature that the mankind lives with relevant literature is 22℃-26℃. The mankind lives or lives think the most comfortable temperature is 24±2℃ in other words. Taiwan is located in the subtropical zone, the average temperature of winter: 15℃-25℃, the average temperature of summer: 25℃-38℃. If look over simply. Taiwan should belong to the country suitable for living with the temperature view. However, Taiwan is surrounded by sea on four sides, belongs to the island type climate, the humidity is originally a bit high. In addition, Taiwan is close to the Pacific Ocean, the location is in monsoon to take; because plum rains, Northeastern monsoon or typhoon of every year, is that Taiwan brings the plentiful rainfall. In addition, the convective rain of Taiwan is vigorous, lead to the fact the humidity of Taiwan remains high, except that movable property or real estate is apt to be decreased by moisture corrosion and water, temperature is suitable for the climate environment a bit high in humidity, become microorganism, bacterium, mould, insect grow hotbed multiplied also, cause the epidemic situation of plant diseases and insect pests to increase [51].

The indoor relative humidity of the building is too high or too low, all exert an unfavorable influence as to living at home. Is the humidity too high, apt to be stale and causing the Dermatophagoides pteronyssinus. No matter the Dermatophagoides pteronyssinus, the Dermatophagoides pteronyssinus excrement, Dermatophagoides pteronyssinus body, the corpse will all become children's anaphylactogen; However, too low for humidity, to people, it is astringent to be apt to cause skin chap, eyes or the universe of nose mucous membrane, easy to be rubbed the static that is produced to shock by electricity. Point out in the literature: The relative humidity of the most suitable life of human house: 45%- 55% RH. Want, let people feel comfortable, can't consider relative humidity take suitable temperature collocate even only. Because the higher temperature is, the more air vapor is. So is the higher for temperature, the relative humidity does not let people feel comfortable until being the lower; Come oppositely to say, the lower temperature is, the higher soon the relative humidity will be. But the too high or pass and low humidity is not good to the health. When the temperature is 35℃, the relative humidity 35% RH will be more comfortable; Centigrade of temperature is at 30℃, the relative humidity 45% RH will be more comfortable; The temperature is at 25℃, the relative humidity 55% RH will be more comfortable. The house humidity relates to human comfortableness, physiology, hygiene and health. Degree is while rising, the human

body releases too much heat with the perspiration. Look on as the environmental relative humidity, the human body is unable with the release heat of the perspiration, will feel uncomfortable. Besides perspiration, the human body can evaporate the internal moisture with skin and respiratory system, use to regulate the body [51]. Influence the skin to evaporate the moisture factor, also relate to environmental relative humidity of the house besides cortex surface state [52, 53]. Temperature and humidity of the climate environment, reciprocation and then the human physiology of influence or quantization indicator of the psychology, in 1959, Thom E. C. [54] Propose: Uncomfortable index Discomfort Index (DI) Concept. Point out and act as (DI) while studying Will feel slightly hot that up to 75- 80, will feel hot and will sweat at 80- 85 will feel hot driving people up a wall when the 85 more than.

Will moreover influence study state and working efficiency of “learner” or “staff members” in the building room respectively when the warm humidity changes. The research results are pointed out [55]: When improving the temperature of indoor air conditioner, can be by method to reduce humidity, to promote indoor personnel's satisfaction. Secondly appropriate to reduce indoor ambient temperature, can raise psychology satisfied reaction and working efficiency. Moreover examined personnel but the speech to studying, under different indoor environmental conditions of warm-heat evil, match 40% of humidity and temperature and 22.0℃ and match 60% of humidity with 22.0℃ of temperature, the warm damp condition in two kinds of rooms, benefit for improving ' working efficiency ' to some extent. And reflect and investigate the result of study and learn, the environmental condition of the best warm humidity is 22.0℃ of temperature in the room according to the psychology, 60% of humidity.

In addition, can still be learnt by this research results, in the same humidity (40%) Under the condition, (28℃> 22.0℃) when the ambient temperature is the higher, One's own satisfaction to the job will be thereupon reduced. Temperature is 22.0 ℃ and 40% and 60% of humidity, for environmental conditions of better warm-heat evil of promoting “working efficiency”. At the same temperature (22.0℃), 40% of humidity and humidity and 60% of the two, the influence on working efficiency has not been showing the difference.

RESEARCH APPROACH

The place of the angry glue of living beings is collected in this research, is one public library in the peach garden county. The experiment measures the reason why the target chooses this particular use of the library, explain and show as follows:

1. The environmental protection administration of executive organ surrounded the indoor air quality proposing value of the letter announcement No. 0940106804 of administration's empty word according to December 30, the 94th year of the Republic of China, the fourth place of “the 1st kind” of item 1, include: “school and educational place, children travel the place, medical place, old man or disability look after the place”. But has not enumerated this kind of place of the “the library”. In order to find out about the library indoor air quality of place of this particular use. This research chooses library as the research object.
2. Except the library can meet general people's curiosity, increase knowledge and substantiate and can study from my essence, the library has already become a part of people's daily life, the wide place that has been liked by nearby residents and often called on now. Worth studying, the contribution degree is high.
3. The library is based on its particular function demand, except that the scale of the

building, set up the position and because in conformity with local government's special requirement, and slightly outside the difference, the planning, design, space of every place dispose and use properties in the library hall, very much the same. After selecting the representative target, its applicability of result of study is relatively wide.

Originally study the department and use “the impacted taking a sample device” (Buck, Bio-Culture B30120), Smoke the air sample breathing in right amount of volume, and assault the sample on the culture medium suitable for fungus growth directly. Train it in the course, train the ambient temperature: 30± 1℃, train time: 48±2hrs, culture medium take a sample medium as TSA (Tryptone Soy Agar) ,Its main component is agar (Tryptone, Soy peptone Nacl, Agar) ; The flow of the taking a sample device: 100L/min; The time of taking a sample: 1min; Take a sample in month: February and April; Take a sample in period: 09:00,12:00, It amounts to three periods of period at 15:00; Take a sample and click the density: Big or small in area according to the floor of floor and determines, every 500- 1,000m2 sets up one is gathered and clicked. Relevant experimental facilities and step show as below:

1. The impacted taking a sample device, as show in fig 1.

Traditional Plate Counts with High Flow Rate *Bioluminescent ATP-assay* *The Sieve Air Sampler*

Figure 1 The impacted taking a sample device, source of the photo [15]: Bioluminescent ATP-assay

2. Experiment step: Plate Count Agar (air sampling) ,Culture medium cultivates the microorganism (Such as fungi), Incubation (48hr) ,calculate the microorganism (Such as the fungi or bacterium), enumeration(CFU/m^3) .
3. The colony is counted: Train the microbial quantity of the ware, fetch $\log_{10}$, count (CFU) for the colony (Colony forming units) .
4. Colony thickness: And then change into the microbial colony thickness (CFU/m^3) via calculating.

RESULT OF STUDY

This research object is one public library in the peach garden county, it was according to period that this library was created in 1923, lie in the special zone of county government of garden of peach, carry on it in the experiment course of microbial colony thickness, must obtain management unit agree, try hard, lower people to be inconvenient outside. Should consider representativeness and integrality of taking a sample. In other words, besides should overcome the human factoring, the necessities and importance of some quantity, etc. that must consider taking a sample in the floor scrupulously, take a sample in the field and take a sample. After considering all subjective and objective influence factors, determine to carry on the date of taking a sample finally: February 24 and April 7; Take a sample in the floor: The

1st floor, the 4th floor and the 5th floor; The place of taking a sample: 7 piece place (Information department, periodical room, reading room for children, seeing and hearing classroom, open-shelf reading room, last room and reading rooms ordinary) ,The samples are lighted 84 altogether.

1. enter the total number of person of the hall and colony thickness are related

Learnt by the experiment materials, it is 467 to enter the total number of person of the hall on February 24, the thickness average of the colony is 104 (CFU/m^3) on the same day, It is 374 to enter the total number of person of the hall on April 7, 2010, the thickness average of the colony is 211 (CFU/m^3) on the same day ,If according to general people's cognition, always thought activity the total number of person was the more in the library, it is the greater to present the angry glue probability of living beings, the colony thickness of April 7 the same day should be higher than February 24. But experimental result happens that the opposite answer appears. If regard thickness average of the colony as the parameter of depending on, count the scale in order to probe into the factor with people, utilize SPSS to learn, personnel count with the thickness average of the colony after counting the software and carrying on LSD multiple comparative analysis, have not been showing the relation ($p> 0.05$) . In addition, even when being the same in case of the same use (area), Adopt user's density ($People/m^2$) when the view probes into the colony thickness, it is also unable to demonstrate and show the relation ($p> 0.05$). The research results that experimental result and literature of this research describe: ' the total number of the colony in the indoor air is influenced by a lot of factors, such as personnel's density of the room ' [13], not all the same.

In fact, no matter any place, propose pondering over the looks corresponding relation of “personnel's quantity” and the two of “colony thickness” from the following two views. First, the angry glue of living beings of outside is the larger in quantity on the spot, and personnel enter internal number of people in the place from outside the more, the probability of internal colony thickness rising of this place thereupon increases. Second, if does not consider the angry glue quantity of living beings of outside of building first, has already had angry glue of living beings as entering the internal personnel in the place, then living beings angry glue quantity in the place, will with enter place personnel increase and increase. In other words, indoor colony thickness, besides relating to outdoor colony thickness, also relate to personal sanitary condition. Suppose the outdoor surrounding air is best in quality, and personnel's hygiene state is good, even more personnel enter the library, the indoor colony thickness will not show the change because of increasing in number of people.

2. Relation between height of the floor and time of taking a sample and colony thickness

Besides special circumstances, general people could reach the other floors through the 1st floor. So is being the same in environmental cases outside, the first floor is people's only way which must be passed, judged the first floor presents the angry glue probability of living beings and higher than the other floors by the convention. But can learn after carrying on LSD multiple comparative analysis according to the experimental result of this research and with SPSS software, there is no direct corresponding relation ($p> 0.05$) in colony thickness and height of floor. Secondly, the angry glue of living beings can be direct or indirect, can be with the morning or in the evening, any time point is entered and stayed in the library. So the

colony thickness, will not show the difference ($p > 0.05$) because of time is different to take a sampling in the library.

3. Relation between the area of floor of floor and colony thickness

This research is in 7 places separately (information department, periodical room, reading room for children, seeing and hearing classroom, open-shelf reading room, last room and reading rooms ordinary) carry on the angry glue of living beings and take a sample, and learn after carrying on LSD multiple comparative analysis with SPSS software, the higher it does not represent colony thickness that the larger the area of floor of floor is. The area size of floor of floor and thickness average of colony, it is being related ($p > 0.05$) that the two have not been showing. This situation can prove by aforesaid living beings angry glue sampling method [13]. Literature point out "small living beings angry glue among air, easy to bully, flow, influence more unstable, so unable to control the angry glue of living beings effectively down". So can learn, the angry glue of living beings fluctuates with the air current, fall in each corner in training wares or ground at random. Generally speaking, receive will to the angry glue probability of living beings the higher when the area is the larger, but there is no absolute relation. For example, as the building opened the muzzle to just face the outdoor high pollution sources, or the personnel who it happened that enter this place are all carriers. Under this situation even the area of place is relatively small; its thickness of colony will also be higher than the floor of building in the place larger in area.

4. The place uses the relation between properties and the colony thickness

Can learn, the top three supreme in thickness of the colony are in the library in order after being analyzed by the experimental result and SPSS software: "periodical room", "the reading room for children" and "open-shelf reading room"; Lowest in thickness with the colony among them, as shown in Table 3.

Regarding thickness average of the colony, consult the room and show the difference nature ($p<0.05$) with the periodical room, reading room for children and open-shelf reading room separately ,As shown in Table 4. To this phenomenon, the administrative staff of the library, should check the place that indoor air quality is worse, whether because the air conditioning causes efficiency to be relatively bad too old; Because to furnish too the crowdedness and space are overly closed, result in ventilating badly. By investigating live that learns, "consult the room" the foreign window has not been furnished the direction parallel to window by the indoor art work or stopping, indoor bookshelf of book case, ventilate and the day lighting state is good, and consult the room and has not offered the desk chair for the persons who read to use, comparatively speaking the time that personnel stay in this place is relatively short.

Table 3 Average number value of the angry glue of living beings of all kinds of places

Describing statistic: Thickness average of the colony							
	Average	Standard deviation	standard misses	average 95% trust range		Minimum	Maximum
				Low bound	Upper bound		
Information room	101.0000	70.66824	28.85019	26.8382	175.1618	33.00	193.00
Reading room for children	208.3333	63.06082	25.74447	142.1551	274.5116	100.00	280.00
Consult room	70.0000	61.64414	25.16611	5.3084	134.6916	5.00	175.00
Periodical room	215.0000	148.35768	60.56677	59.3082	370.6918	95.00	475.00
Open-shelf reading room	202.5000	159.86713	65.26548	34.7297	370.2703	55.00	510.00
Look and listening room	183.3333	155.77762	63.59595	19.8547	346.8119	20.00	440.00
Ordinary reading room	122.5000	48.86205	19.94785	71.2224	173.7776	85.00	210.00
Total	157.5238	116.75474	18.01565	121.1405	193.9071	5.00	510.00

Table 4 consults the difference between the room and colony thickness of other types place

place (I)	place (J)	Average difference (I-J)	standard misses	Dominance	95% trust range	
					Low bound	Upper bound
Consult room	Information room	-31.00000	64.36219	.633	-161.6622	99.6622
	Reading room for children	-138.33333*	64.36219	.039	-268.9955	-7.6711
	Periodical room	-145.00000*	64.36219	.031	-275.6622	-14.3378
	Open-shelf reading room	-132.50000*	64.36219	.047	-263.1622	-1.8378
	Look and listening room	-113.33333	64.36219	.087	-243.9955	17.3289
	Ordinary reading room	-52.50000	64.36219	.420	-183.1622	78.1622

* The average difference is apparent at 0.05 levels

5. Relation between temperature or humidity and colony thickness

This research takes a sample in the angry glue of living beings in the course, warm humidity ranges in the room are: Temperature: 20.2℃-25℃; Humidity: 49.2%- 69.0%. Analyze that learns according to the experimental result and SPSS software, as shown in Table 5. Act as temperature range in order: Small at 22.1℃, is between 22.1℃ and 23.7℃ and big at 23.7℃, the averages of the colony thickness are: 106.3 CFU/m^3, 154.2 CFU/m^3 and 205.2 CFU/m^3. Moreover this research is with February 24 diurnal average temperature, average humidity (22.1℃, 64.6%) separately And 7 diurnal average temperature, average humidity (23.7℃, 56.1%) in April, Click in the sector that counts the software and analyzes as SPSS, as Table 5 and Table 6 shows. Can be learnt by Table 6, when the block of temperature is between 20.2℃ and 25℃, temperature small colony thickness and large colony thickness at 23.7℃of temperature at 22.1℃, the two have apparent difference nature ($p<0.05$). And is learnt by the statistical data, the big colony thickness at 23.7℃of temperature exceeds the small colony thickness at 22.1℃of temperature. The colony thickness relates to temperature. Rise with temperature colony thickness have trend of increase.

Can be learnt by Table 7, when humidity range is between 49.2% and 69.0%, the humidity is smaller than 56.1% of the colony thickness and humidity and lie between the colony thickness of 56.1% and 64.6%, the two show the difference nature (P<0.05). And the humidity is smaller than 56.1% of the colony thickness and humidity and greater than 64.6% of the colony thickness, the two also show the difference nature (P<0.05). And is learnt by the statistical data, the humidity is smaller than 56.1% of the colony thickness and exceed the humidity and is greater than 64.6% of the colony thickness. If regard colony thickness as the parameter of depending on again, and regard humidity as the independent variable, analyze that learn, humidity and the two of colony thickness have dominance (P<0.05), As Table 8, Table 9 and Table 10 shows. Can learn lie between 49.2% and 69.0% by range as humidity, humidity high colony thickness little while being described above. Return to equation preface to show as follows:

$$y = -0.438x \quad (1)$$

However, while considering the two of temperature and humidity influence the colony thickness at the same time, it is unable to show the relation (P>0.05), As Table 11 and Table 12 shows. Stated, perfectly in harmony or agreement without previous consultation this phenomenon and literature [20]. Whole but the speech, influences the influence factor of colony thickness of the library to use properties by indoor humidity, indoor temperature and field.

Table 5 different temperature situations make the average of the colony thickness

Describing statistic: Thickness average of the colony							
Temperature range	Average Standard	deviation	standard misses	Average 95% trust range		Minimum	Maximum
				Low bound	Upper bound		
< 22.1℃	106.3333	78.63417	22.69973	56.3716	156.2951	20.00	280.00
22.1℃～23.7℃	154.1875	117.01807	29.25452	91.8330	216.5420	5.00	475.00
> 23.7℃	205.2143	130.68410	34.92680	129.7595	280.6690	45.00	510.00
Total	157.5238	116.75474	18.01565	121.1405	193.9071	5.00	510.00

Table 6 dominance of different temperature of thickness average of colony

Temperature range (I)	Temperature range (J)	Average difference (I-J)	standard misses	Dominance	Average 95% trust range	
					Low bound	Upper bound
< 22.1℃	22.1℃～23.7℃	-47.85417	43.04164	.273	-134.9141	39.2058
	> 23.7℃	-98.88095*	44.33966	.032	-188.5664	-9.1955
22.1℃～23.7℃	< 22.1℃	47.85417	43.04164	.273	-39.2058	134.9141
	>23.7℃	-51.02679	41.24744	.223	-134.4576	32.4040
> 23.7℃	< 22.1℃	98.88095*	44.33966	.032	9.1955	188.5664
	22.1℃～23.7℃	51.02679	41.24744	.223	-32.4040	134.4576

* The average difference is apparent at 0.05 levels

Table 7 different humidity situations make the average of the colony thickness

Describing statistic: Thickness average of the colony							
Humidity range	Average	Standard deviation	standard misses	Average 95% trust range		Minimum	Maximum
				Low bound	Upper bound		
< 56.1%	245.8000	132.05538	41.75958	151.3333	340.2667	110.00	510.00
56.1%～64.6%	139.7500	106.47751	23.80910	89.9170	189.5830	5.00	475.00
> 64.6%	113.5833	84.81258	24.48328	59.6960	167.4707	20.00	270.00
Total	157.5238	116.75474	18.01565	121.1405	193.9071	5.00	510.00

Table 8 dominance of different humidity of thickness average of colony

Humidity (I)	Humidity (J)	Average difference (I-J)	standard misses	Dominance	Average 95% trust range	
					Low bound	Upper bound
< 56.1%	56.1%～64.6%	106.05000*	41.67107	.015	21.7623	190.3377
	> 64.6%	132.21667*	46.06910	.007	39.0331	225.4002
56.1%～64.6%	< 56.1%	-106.05000*	41.67107	.015	-190.3377	-21.7623
	64.6%	26.16667	39.28786	.509	-53.3005	105.6339
> 64.6%	< 56.1%	-132.21667*	46.06910	.007	-225.4002	-39.0331
	56.1%～64.6%	-26.16667	39.28786	.509	-105.6339	53.3005

* The average difference is apparent at 0.05 levels

Table 9 colony thickness and humidity on average regression equation R^2

model	R	R^2	estimate after R^2	adjusted standard misses	changing amount				
					R^2 changing amount	F change	df_1	df_2	dominant F to change
1	.438[a]	.192	.172	106.25619	.192	9.502	1	40	.004
a. Predict parameters: (constant) ,Average humidity									

Table 10 dominance regression equation between colony thickness and average humidity

Coefficient[a]						
model		Not standardized coefficient		Standardized coefficient	t	dominance
		B estimated value	standard error	Beta distributed		
1	(constant)	726.835	185.414		3.920	.000
	Average humidity	-9.432	3.060	**-.438**	-3.083	.004
a. Depend parameters: Thickness average of the colony						

* The average difference is apparent at 0.05 levels

Table 11 R^2 of temperature and humidity interaction between colony thickness average

model	R	R^2	R^2 is adjusted alters statistic by mistake	Estimate standard misses	changing amount				
					R^2 changing amount	F changes	df_1	df_2	dominant of F change
1	.314[a]	.099	.076	112.21624	.099	4.383	1	40	.043
2	.451[b]	.204	.163	106.82815	.105	5.137	1	39	.029
3	.457[c]	.209	.146	107.86517	.005	.254	1	38	.617

a. Predict parameters: (constant), Average temperature

b. Predict parameters: (constant), Average temperature, average humidity

c. Predict parameters: (constant), Average temperature, average humidity, temperature multiplies humidity

Table 12 dominant of temperature and humidity interaction between colony thickness averages

model		Not Standardized coefficient		Standardized coefficient	t	dominant	synteny statistic	
		estimated value of B	standard error	Beta distributes			and permits difference	VIF
1	(constant)	-472.942	301.625		-1.568	.125		
	Average temperature	27.534	13.151	.314	2.094	.043	1.000	1.000
2	(constant)	1361.262	858.722		1.585	.121		
	Average temperature	-17.883	23.629	-.204	-.757	.454	.281	3.562
	Average humidity	-13.159	5.806	-.611	-2.266	.029	.281	3.562
3	(constant)	1146.503	966.218		1.187	.243		
	Average temperature	-12.787	25.914	-.146	-.493	.625	.238	4.203
	Average humidity	-11.690	6.548	-.543	-1.785	.082	.225	4.444
	temperature multiplies humidity	-11.349	22.532	-.081	-.504	.617	.802	1.248

a. Depend parameters: Thickness average of the colony

CONCLUSION AND SUGGESTION

This research is to regard one public library in the peach garden county as the research object, utilize the assaulting device (Bioluminescent ATP-assay) With the software of statistical analysis (SPSS) Wait for tools, the ones that probe into various factors and colony thickness of library are related. Can learn, the colony thickness of every place of this library is all smaller than 500 CFU/m3 according to the result of study, accord with suggestion value of 1st kind of environmental protection administration. Moreover according to the statistical analysis data, can learn the indoor colony thickness and enter factors such as the total number of person, height of the floor, sampled time, area of floor of the library, etc., it is not related. Colony thickness and ambient air quality of the building in the library, passing in and out the

personal sanitary condition of the people and staff member to have something to do with, influence the main factor of the colony thickness of the library, include: Indoor humidity, indoor temperature and use property.

To place of this particular use of the library, should be by “the safe save of the books file in the library”, “use the people's health with comfortableness” in order to consider the direction. To two aforesaid general orientations, its situation influencing the factor to be numerous and the interaction often take place, pinning down each other. As for safe save of the books file, testing it factor, including mould, fungi, bacterium and radiating fungus causing “mould and rotten”, “change color” or “go bad”, etc. question; Secondly it is clothing fish, book louse and wooden termite of the universe, etc. that regard paper books as the insect of the food, unprincipled to gnaw questions such as the books, etc.. Finally: Whether the warm humidity will cause questions such as the brittle rupture of the paper and making moist, etc. Separately as for the people's health and comfortableness: Except that comfortableness involves the personal adaptive capacity and psychology and experiences subjectively, microorganism and small particle, fleas, dust coming out by little organism release in the air. When all relating to the fact that the people are healthy. Want, give consideration to “books safe save of file” and “health and comfortableness of people” at the same time, and often make the administrator in a dilemma, in a dilemma. Study, learn, can set up appropriate mechanism of management, room temperature and humidity of internal environment control properly, can easily solved up to the result getting twice the result with half the affording aforesaid important problem.

Learn after this research reviews with statistical analysis with the literature, colony thickness, mould (or the bacterium) Survive with breeding, so as to the mould (or the bacterium). It is insect of the food, paper books file that are made moist brittle rupture, personnel in indoor psychology reacting and working efficiency, etc., all relate to warm humidity environment in the library room. The warm humidity is a key factor of influencing every factor described above. The colony thickness presents the trend increased when rising in ambient temperature, look on as the environmental humidity the higher the colony is the lower in thickness. However, if the one that consider the warm humidity to colony thickness at the same time is related, do not have dominance ($p > 0.05$) . Learnt by this result of study, the best temperature range of library is 20℃ - 26℃, and the range of relative humidity is 40%- 60% RH.

REFERENCES

1. The deep blue fine jade of summer, the mould prevention and cure that hurts of the paper historical relic, consult the website: http://140.130.94.202/fps/change/%E5%85%A8.pdf, 2011.
2. Central Weather Bureau, the average meteorological materials of moon, the global information network of Central Weather Bureau, consult the website: http://www.cwb.gov.tw/, 2011.
3. Wang Jun Qin, Chen Shi Fang, forest, spend living beings angry glue person who sample understand Taizhong particular summer microbial kind and research of thickness that atmosphere include in the daytime of place tentatively, Vol. two of science and project technical journal, number four, pp. 7-14,2006.
4. Zhang Han Chang, environmental pollution and preventing and curing, ' develop and publish the Limited Company in new gentle Beijing ', 3rd, 44, 67 Taibei of page, 2004.
5. Lin Wen Hai, Chen Ya Hui, good and former in vain, the angry glue thickness of living beings in the air of the hospital, ' the medical magazine of Zhongshan ', 15, pp.97-107, 2004.
6. Jing Wen Zhang, chapter two the chemical in labourer expose make investigations danger, section eight living beings glues angry - there aren't danger, the technological series of books of research institute of labourer's safe hygiene - labourer's hygiene studies relevant technological data compilation, pp.2-8-1-2-8-7, labourer's safe hygiene research institute of labourer's committee of executive organ, Taibei, 1998.
7. Millner, P. D., S. A. Olenchock, E. Epstein, R. Rylander, J. Haines, B. L. Ooi, E. Horne and M. Maritato, Bioaerosols Associated with Composting Facilities. Compost Science and Utilization, 2(4) , pp.8-57, 1994.
8. Douwes, J., P. Thorne, N. Pearce and D. Heederik. Review: Bioaerosol health effects and exposure assessment: progress and prospects, Annals of Occupational Hygiene, 47(3), pp.187-200, 2003.
9. Sigsgaard, T., P. Malmros, L. Nersting and C. Petersen. Respiratory disorders and atopy in Danish refuse workers. American Journal of Respiratory and Critical Care Medicine, 149, pp.1407-1412, 1994.
10. Li Zhi Shan, a group of relevant properties discussion of indoor air quality and office building morbid state building disease, the news in brief of life sciences, number 2 of Vol. 13, 1999.
11. Robinson, J., W. C. Nelson, National Human Activity Pattern Survey Data Base. United States Environmental Protection Agency, Research Triangle Park, NC, 1995.
12. Lance Wallace, Indoor Particles: A Review, Journal of the Air and Waste Management Association, 46, pp.98-126, 1996.
13. Li Xia, Liu Xiu Yan, Chen Xi Ping, Sun ZongKe, Wang YouBin, Ding Pei, to the sanitary standard of the total number of bacteria in the indoor air, hygienic requirements of the total number of the colony in the indoor air, control centre environment, prevention from suffering from the diseases of China, and health relevant product Ministry of Public Health Policy and Regulations Department / professional committee / standards committee of environmental sanitation of the sanitary standard received safely, work out the group, 2011 in standard of China's Mainland
14. Ministry of Construction of People's Republic, GB 50325, The internal environment pollution control norm of civil construction work room 2001, Beijing: Chinese Plan Press,2006 (2).

15. G. Y. Lomakina, N. N. Ugarova, Monitoring of the microbial contamination of air by bioluminescent ATP-assay, Dept of Chemistry, Lomonosov Moscow State University, Moscow, 119991, Russia.
16. Xin Qiao Wu, Xin Zhao, issue, mayor of Taibei, look after biological job, staff of organization, expose and assess, the public hygiene research institute of medical university of Taibei, master's thesis, 2006.
17. Bai JiaYuan, the biological glue thickness in the air of the hospital, consult the website: http://www.ctitw.com.tw/new6.htm, 2011.
18. Green building materials analyze detection and technological consultation, consult the website: http://www.new-fast.com.tw/serv_green.htm, 2011.
19. Li Li Zhen, the long indoor air quality of taking the picture the organization investigates and discusses with novel clean technology, industry's safe hygiene of University of Science and Technology of good south pharmacology and taking precautions against natural calamities in the research institute, master's thesis, 2010.
20. Xu LiYing, environmental characteristic and fungi expose the discussion on influence to child's breathing problem at home, National Taiwan University public hygiene research institute, master's thesis, 1994.
21. Yu Min Su, atomized bactericide activity microbial control efficiency of thickness assess to indoor air - regard exceeding inferior water once and applying the example to infant's looking after the organization as, National Cheng Kung University environmental medicine research institute, master's thesis, 2008.
22. Environmental protection administration, indoor air qualitative control summary, consult the website: http://aqp.epa.gov.tw/iaq/page1-1.htm, 2011.
23. Subdue the base to know, does the air quality of the hospital send out a warning? Consult the website: http://www.24drs.com/daily/article.asp?x_no=3606, 2011.
24. Li Hui Mei, the research which produces the air anion miniature device that endure the rice carbon and in charge of discharging, the environmental engineering research institute of National Taiwan University, the case study of state science commission of executive organ plans the achievement report, 2006 (NSC 95-2221-E-002 -139 -)
25. Lin Wen Hai, the angry glue sampling device sample efficiency in the environment of all kinds of homework of Andersen living beings is assessed, public health discipline of medical university of Zhong Shan, the case study of state science commission of executive organ plans the achievement report, 2002 (NSC 90-2320-B-040-041)
26. Wang Jun Qin, Chen Shi Fang, forest, spend living beings angry glue person who sample understand Taizhong particular summer microbial kind and research of thickness that atmosphere include in the daytime of place tentatively, number four of Vol. two of, science and project technical journal, pp. 7-14 (2006).
27. Wang ChunHua, Ma HongQiu, Tong LiCi, the roc flies, the building is reconstructed to influence and treatment burning the air quality of operating room, ' the first affiliated hospital of medical university of Anhui, Hefei of Anhui ', date issued of network edition 2009-11-30, http://www.zggrkz.com/CN/abstract/abstract8452.shtml
28. Huang Hong Chen, I am strong, the angry glue of living beings on the traditional market makes up and studies, the scientific and technological university student's thing in south Taiwan is scientific and technological is the special topic of the practice to make achievement report, 2006.
29. Ellerbroek L., “Airborne microflora in poultry slaughtering establishments”, Food Microbiology, Volume 14, Number 6, December pp. 527-531(5) , 1997.
30. K. Kruczalak, K. Olańczuk-Neyman, R. Marks, “Airborne Microorganisms Fluctuations

Over the Gulf of Gdansk Coastal Zone (Southern Baltic)", Polish Journal of Environmental Studies Vol. 11, No. 5 (2002), 531-536, 2002.
31. L. Curtis, S. Cali, L. Conroy, K. Baker, C.-H. Ou, R. Hershow, F. Norlock-Cruz, P. Scheff, "Aspergillus surveillance project at a large tertiary-care hospital", Journal of Hospital Infection 59, 188–196,2005.
32. Pei-Shih Chen, Chih-Sean Ou, Yu-Ting Cheng , "Aspergillus surveillance project at a large tertiary-care hospital", Journal of Hospital Infection 59, 188–196, 2005.
33. Pei-Shih Chen, Chih-Sean Ou, Yu-Ting Cheng, "Characterization of the bacterial and fungal bioaerosols", Kaohsiung medical university, http://aaarabstracts.com/2010/viewabstract.php?paper=838
34. Cynthia Howard-Reed, Lance A. Wallaceb, Steven J. Emmericha, "Effect of ventilation systems and air filters on decay rates of particles produced by indoor sources in an occupied townhouse", Atmospheric Environment 37, 5295–5306, 2003.
35. J. Dutkiewicz, S. Olenchock, E. Krysińska-Traczyk, C. Skórska, J. Sitkowska, Z. Prazmo., "Exposure to airborne microorganisms in fiberboard and chipboard factories", Ann Agric Environ Med; 8(2):191-199, 2001.
36. ShinhaoYang, GraceW.M. Lee, "Filtration characteristics of a fibrous filter pretreated with anionic surfactants for monodisperse solid aerosols", Aerosol Science 36, 419–437, 2005.
37. Ronald E. Gots, Nancy J. Layton, Suellen W. Pirages, "Indoor Health: Background Levels of Fungi", AIHA Journal, 64:427–438, 2003.
38. Robertson, L. D., "Monitoring Viable Fungal and Bacterial Bioaerosol Concentrations to Identify Acceptable Levels for Common Indoor Environment", Energy Systems Laboratory, 1998.
39. D. P. Strachan, B. Flannigan, E. M. McCabe, F. "McGarry, Quantification of airborne moulds in the homes of children with and without wheeze", An International of Respiratory Medicine, 1990.
40. P. Venter, J. F. Lues, and H. Theron, "Quantification of bioaerosols in automated chicken egg production plants", Poultry Science, Vol 83, Issue 7, 1226-1231, 2004.
41. C. H. Luo, S. Yang, Y. C. Huang, "Removal efficiency of bioaerosols by combining negative air ions with electret filters", Proceeding of 11th International Conference on Environmental Science and Technology, Chania, Crete, Greece, 2009.
42. Ventilation for Acceptable Indoor Air Quality, ESl, US (3).
43. Lin Jian, Zheng Yan, the bathroom public apparatus little biological pollution situation investigation of guest room, the medical magazine of Fujian, 23 (5), 2001, pp452-453 (11).
44. Jian Cheng Song, books protect law, classical-collection edition, encyclopaedia of China, 1983, http://ap6.pccu.edu.tw/Encyclopedia/data.asp?id=7461
45. Pinniger, D., 2001, "Pest management in museums", archives and historic houses, Archetype Publications Ltd., London.
46. Yang, Rouling., "Why, How, and When Would Pests Get Into Museums or Archives?" Journal of Cultural Property Conservation, No.13, pp.79-88, 2010.
47. Ecology and prevention and cure of flea, greatly worm Co., Ltd., 2012, http://www.davy.com.tw/flea.htm
48. Introduce the common dust in the family, Nevermite, 2012, http://www.nevermite.com/healthlife.php?id=18
49. Prevent and cure the manual of the dust of the house, http://www.epa.gov.tw/ch/DocList.aspx?unit=21&clsone=509&clstwo=733&clsthree=0

&busin=325&path=14097
50. North municipal government: The child anaphylactogen dust? The crab is in the majority - October 20, 2008 of news of central news agency, http://zh.wikipedia.org/wiki/%E5%A1%B5%E8%9F%8E
51. Theme: Contempt by Vault9. Blog at WordPress.com. http://littlek.wordpress.com/2006/12/12/%E6%89%93%E6%93%8A%E6%BF%95%E6%B0%A3
52. Whitman, Johnson, Tomczyt, "Refrigeration& Air Conditioning Technology", Delmar Publishers, pp.697 ~700 ,2000.
53. ASHRAE, Handbook of Fundamentals, pp.137 ~138 ,2001.
54. E. C. Thom, "The Discomfort Index", Weatherwise, Volume 12, Issue 2, pages 57-61, 1959.
55. Zhou Bo Cheng, Jiang Zhe Ming, Zhang Gui Feng, Guo Yi Jun, the warm environment changes to the study of lessons and discussion on influence of psychological satisfaction of working efficiency in the room of Taiwan, the 67th issue of society's, Journal of Architecture,, Republic of China, page 250, March of 2009 (Journal of Architecture, No.67, pp.25 250 40, Mar. 2009).

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

BRIDGING COMPETENCE AND CURRICULUM FOR COMPLEX CHANGE

Chi-Cheng Chang, Lunghwa University of Science and Technology, Taiwan
Email: chig@mail.lhu.edu.tw

ABSTRACT

Purpose: *The rapid technological changes prompt a company's supervisors and managers to update their management capabilities in order to stay competitive. Aimed at enhancing low-level supervisors' management capabilities, this study explores the training programs that help improve, and are most compatible with, each specific management competency.*
Design/methodology/approach: *Focused on low-level supervisors in the Taiwanese Mold industry, this study was conducted by means of focus group with the competency indicators, training programs and questionnaire confirmed by 32 experts. Through cluster sampling, supervisors at Taiwanese small- and medium-sized Mold manufacturers were surveyed, and competency indicators were derived from answers stated in the 326 valid questionnaire copies returned (at a 66.53% response rate). Finally, 8 experts were consulted as part of a Gray Relational Analysis (GRA) to identify the priority of training programs that matches each specific competency.*
Findings: *Totally 7 indicators and types of training programs are identified with regard to low-level supervisors' competences, and so were the optimal competency-program combinations. GRA was proved an effective way to solve the ambiguity regarding how a given competency is paired with the training programs.*
Originality/value: *The findings solve the ambiguity regarding how the emerging requirements for management competences, which are resulted from technological advances, are responded with appropriate training programs. The types of training programs identified provide a foundation for on-the-job training. The findings also prove GRA a reliable approach to finding the type of training program most suitable for a particular competency.*

Keywords: Low-level supervisors, Management competence, Training programs, GRA

INTRODUCTION

In the process of corporate operations, the rapidly changing technological aspect keeps generating new requirements for employee competences (Dumas & Hanchane, 2010). It is therefore a challenge for a company's human resources development staff to cultivate new competences, and subsequently ensure productivity and market competitiveness (Holden & Griggs, 2010; Chang, 2012b). Many empirical studies indicate how technological advancements result in extra requirements for an employee's knowledge and skills (Gashi et al., 2010), how training leads to higher corporate competitiveness (Dumas & Hanchane, 2010) and how urgent it is to offer on-the-job training for supervisors. Because training directly improves the trainees' productivity while enhancing their performance in such areas as strategies, organizational decision-making and innovation (Dumas & Hanchane, 2010), it is

extremely important to teach or train supervisors to handle changes by taking appropriate measures, so they may eventually deliver performance at work (Amran *et al*., 2011).

The competences of low-level supervisors determine a company's quality of production, which is closely linked to corporate operating performance (Palvia *et al*., 2010). Such competences can be further divided into core competence, professional competency, management competence, general competence (Lei & Slocum, 1992) and dynamic capability to grasp dynamic environments (Chang, 2012a). Each competence is considered a combination, or a set, of capabilities attached to an individual (Sora *et al.*, 2010). Given the fast-changing technological environment nowadays, it is imperative that managers engage themselves in continuous learning in order to meet the organization's need for sustainable transformation.

It is an important issue to meet the emerging requirements for competences and find training programs that match those needs (Marzo-Navarro *et al.,* 2009). Previous researchers on related topics usually adopted such approaches as expert consultation and survey research. Vincent and Focht (2009), for one, combined expert consultation and the Q-sort method in their exploration of how the training curricula for environmental program managers were designed to match their core competences, while a survey research of Marzo-Navarro *et al*. (2009) examined the gap between competences required by companies and those emphasized in the college curricula. These studies underscored the necessity and benefits of combining experts in a particular field with a quantitative research approach.

Taiwan's highly competitive Mold industry boasts a comprehensive supply chain that comprises 3,416-odd firms and approximately 38,800 employees as of 2006, which also makes mold the largest among the country's metal manufacturing industries (MOEA, 2007). A company will never stay competitive without continuously training its low-level supervisors for improved management capabilities. To expedite the research process, this study's author defined *low-level supervisors*, namely those supervising at the section, shift or division levels (including foremen), as employees whose primarily duties are executing tasks, improving work efficiency, and accomplishing day-to-day assignments. *Management competences* in the present study refers not only to the ability of low-level Mold company supervisors to wisely use organizational resources, but also to the knowledge, skills and attitude that contribute, and add value, to the organization. *Training programs*, on the other hand, are defined as on- or off-the-job educational courses officially offered by a company to its low-level supervisors during the employment contract period, with an aim to bolster those supervisors' management competences in accordance with its production initiatives.

LITERATURE REVIEW

The Mold industry is both technology- and capital-intensive in nature, with a distinctively high value-added ratio. It is safe to say the requirement that low-level Mold company supervisors keep improving their management capabilities is derived from the *endogenous growth model* (Romer, 1986), which suggests a corporate organization's overall capabilities grow in proportion to its individual departments' capabilities (Romer, 1986). In each company department, it is imperative that low-level supervisors as an integral part of production initiatives update their management competences to ensure corporate competitiveness. In an exploration of the *fit* between competences required for a job position

and job assignments on the personal level, Bretz and Judge (1994) put forth the theory of vocational fit. Likewise, Seethamraju (2012) used the fit theory trying to achieve a high degree of correlation between corporate operations and business education curricula. Apparently, it is imperative that the planning of training programs fit the requirements for employee competences.

Indicators of management competences

The effects of technological changes on management practices are exemplified by team-oriented tasks, the "just-in-time" production strategy, and the quality control circle (Gashi *et al*., 2010). Generally speaking, indicators of management competences are summarized from either the structural or the behavioural perspective. Noe (2005), for one, took the structural perspective to identify 6 indicators from the viewpoint of "managing cultural diversity," namely cost, resource-acquisition, marketing, creativity, problem-solving and system flexibility.

For instance, the relationship-management capability from the behavioural perspective has an implicit impact on the *quality* (Palvia et al., 2010). Lyons (2012) mentioned 10 innovative leadership capabilities: problem-framing, opportunity recognition, experimentation, revenue model innovation, valuation of ideas, risk selection, influence without authority, manage ambiguity/conflict, team creativity, and adaptive governance. Meanwhile, thinking/analysing skills, knowledge of management details, applying theory, professional and personal development, team skills are the five indicators to determine whether the learners' competences vary among learning styles (Rodwell, 2005). According to Liu *et al*. (2010), businesses in the manufacturing sector must focus on the management of uncertainties concerning supply and demand in order to develop the mass customization ability.

From the behavioural perspective, this study's author proposed some indicators to measure management competences that help supervisors adapt to an ever-changing environment, as listed in Table 1.

Table 1 Operational Definition of Indicators of the Management Competences of Low-Level Mold Company Supervisors

Primary indicators	Secondary indicators	Definition
(1).Communication/negotiation capability	Listening skills; self-expression skills; negotiation skills	The capability of negotiating with higher-level supervisors, listening to the subordinates, conveying work-related information, and coordinating inter-departmental operations.
(2). Capability as a team leader	The skill of influencing subordinates; the skills of creating the workplace atmosphere; and the conflict management skill	The capability of delegating/monitoring works, setting up work-oriented teams or task forces to ensure the goals are timely achieved, and creating a teamwork-oriented atmosphere in the workplace.

(3). Social-networking capability	The social-networking skills; the skills of motivating subordinates; the skills of incentivising subordinates.	The capability of wisely using social networks, encouraging subordinates to improve production efficiency/quality, and generating benefits for the production initiatives.
(4). Decision-making capability	Planning skills; monitoring skills; problem-solving skills; authorization	The capability to conduct production scheduling, timely solve production-related problems and customer complaints, while in the mean time promoting the efficiency of production line.
(5). Mold-relevant derivative intelligence	Continuous learning; creativity	The ability to win the subordinates' recognition for Mold-related expertise and subsequently achieve management effectiveness; to continuously acquire Mold-related knowledge/skills while applying creativity and innovative thinking to work.
(6). The customer-service capability	The skill of grasping customers' needs; the skills of building relationships; the skills of handling complaints.	The capability of timely responding to, and meeting, customers' needs; making the company more reliable among customers; improving customer loyalty.
(7). The ability to maintain system flexibility	The adaptability to technological evolution; the capability to use high-tech equipment/ tools	The ability to use high-tech equipment, new tools and incorporate production-related needs into plans or designs of new processes in accordance with emerging and ever-evolving technologies.

Types of training programs

Training is considered the source of corporate competitiveness (Dumas & Hanchane, 2010). In response to the changing circumstances, an organization must factor diversity management into the training programs (Danowitz et al., 2009). Topics of the training programs include: 1. organizational theories; 2. human resource management; 3. instruments of gender and diversity management; 4. special methods for organization studies; 5. participatory organizational design; 6. teambuilding; 7. legal regulations for gender and diversity management; 8. personality development; 9. gender and diversity theories; 10. labour market theories from gender and diversity perspectives; 11. project-seminar (Danowitz et al., 2009).

According to Gashi et al. (2010), team-working and quality circles both help corporate managers develop the change-adaptable management competences. Training programs

responding to the need for innovative leadership (Lyons, 2012) include: (1) data and decisions; (2) economics for business decision-making (microeconomics); (3) leading People; (4) problem-finding and problem-solving; (5) financial accounting; (6) introduction to finance; (7) marketing management; (8) leadership communication; (9) operations management; (10) macroeconomics in the global economy; (11) strategic leadership; (12) ethics and responsibility in business.

To sum up, the 7 types of training programs contributing to the management competences include: interpersonal communication, team leadership, problem-solving and analysis, recognition of roles and responsibilities, work instructions, motivation, and executability.

METHODOLOGY

Focus group interviews

The method proposed by Krueger and Casey (2000) was used in the present study. Convenience sampling was conducted to select 32 experts, or supervisors/managers at small- and medium-sized Taiwanese Mold manufacturers who have 15 or more years of work experience and are in charge of on-site management (including 12 mid-level and 20 low-level supervisors). The experts were convened for 3 discussion sessions, where they established management competence indicators while confirming the questionnaire and types of training programs.

The survey research method

Questionnaire development: Based on the literature review and operational definitions of competence indicators, a draft questionnaire was developed and then confirmed by the experts. The questionnaire is made up of 50 questions that involve the communication/negotiation capability (A1-A8), the capability as a team leader (B1-B7), social-networking capability (C1-C5), decision-making capability (D1-D9), Mold-relevant derivative intelligence (E1-E8), the customer-service capability (F1-F7) and the ability to maintain system flexibility (G1-G6).

Data collection: cluster sampling was used to collect data, with the details stated below:

a. Type of Mold firms selected: In this study, four sub-groups (i.e., stamping, plastic moulding, die-casting and forging) of metal mold companies were examined;
b. Percentages of sampling distribution: The percentages were determined on the basis of the number of Taiwan's existing Mold firms and the distribution of Mold employees. The researcher surveyed 92.2% of the employees for Mold firms with fewer than 30 workers; 6.9% for those with 30-99 workers; 0.6%, firms with 100-199 workers; 0.2%, firms with 200-299 workers; 0.1%, firms with more than 300 workers.
c. Distribution of questionnaire: Totally 490 copies of questionnaire were first sent out through post services and then through e-mail. Having reminded, by way of e-mail correspondence, the respondents to send back their copies of completed questionnaire, the researcher received 326 valid copies of questionnaire after deducting those not answered by low-level supervisors. The response rate is 66.53%.
d. Data analysis: Based on the Grey Relational Analysis (GRA) method, the data collected was analyzed to examine how much the management competence indicators are related

to their corresponding training programs. Mid-level supervisors (5) and experts in the field of Mold (3) were selected from small- and medium-sized, Taiwan-based multinational Mold companies as the *experts*, who then answered questions concerning the management competence indicators and their corresponding training programs. The research project was concluded using the GRA proposed by Teng (2003).

RESULTS

Descriptive statistics of the sample

Males and females account for 71.4% and 28.6% of the survey responses, respectively. As far as age is concerned, people aged 31-40 represent the largest portion of the sample (53.2%), followed by those aged between 41 and 50 (28.6%), which suggests that low-level Mold company supervisors are mostly young or middle-aged. People with a seniority of 1 to 5 years account for 16.7% of the responses; 6 to 10 years, 15.9%; 11 to 15 years, 34.9%; 16 years or longer, 32.5%, a sign that a relatively large percentage of Mold company employees have a seniority of 10 or more years.

Reliability and validity of the questionnaire

As far as reliability is concerned, the questionnaire has an overall 0.939 Cronbach's Alpha, with Cronbach's Alpha values for individual questions ranging from 0.936 to 0.939, hence the satisfactory consistency and stability among those items. Meanwhile, the questionnaire was proved to have content validity as the focus-group experts used management competence indicators to make sure it correctly appraised the content intended for measurement in terms of correctness and effectiveness.

Grey Relational Analysis (GRA)

(1). Determining the importance weights

Table 2 shows how the experts (E) prioritized the management competence indicators (on a scale of 1 to 7, 1 being the most important and 7 the least important) according to how important they are. Those indicators include communication/negotiation capability (CA), the capability as a team leader (TA), social-networking capability (RA), decision-making capability (DA), Mold management intelligence (DK), the customer-service capability (CS) and the ability to maintain system flexibility (SA). Table 3 shows how the types of training programs are prioritized, including programs in interpersonal communication (RC), team leadership (TC), problem-solving and analysis (PS), perceptions of roles and duties (RD), work instructions (WC), motivation (EC) and executibility (PC).

Table 2 Prioritizing the Management Competences by Importance

	Indicators	E1	E2	E3	E4	E5	E6	E7	E8
Management competences	CA	2	3	1	1	1	4	1	2
	TA	3	2	6	2	3	1	2	4
	RA	5	4	7	4	5	5	5	3
	DA	4	1	2	3	2	3	3	1
	DK	1	7	3	7	4	2	6	7
	CS	7	6	5	6	6	6	7	6
	SA	6	5	4	5	7	7	4	5

Table 3 Prioritizing Different Types of Training Programs

	Programs	E1	E2	E3	E4	E5	E6	E7	E8
Types of training programs	RC	4	4	7	1	4	6	1	6
	TC	3	3	6	4	5	3	5	3
	PS	1	2	1	2	1	2	3	1
	RD	7	1	2	5	2	1	2	2
	WC	6	5	3	7	6	5	4	4
	EC	5	7	5	6	7	7	7	7
	PC	2	6	4	3	3	4	6	5

(2). Establishing the sequence correlation

Table 4 shows the data was examined using the grey relational analysis software, with *management competences* being the main factor $\chi_i(k)$ and the *type of training program for management competences* being the sub-factor $\chi_j(k)$.

Table 4 Referential and Comparative Sequences Derived from the Grey Relational Analysis

Main factor $\chi_i(k)$ (referential sequence)	Sub-factor $\chi_j(k)$ (comparative sequence)
CA $\chi_{i1}(k)$	RC $\chi_{j1}(k)$
TA $\chi_{i2}(k)$	TC $\chi_{j2}(k)$
RA $\chi_{i3}(k)$	PS $\chi_{j3}(k)$
DA $\chi_{i4}(k)$	RD $\chi_{j4}(k)$
DK $\chi_{i5}(k)$	WC $\chi_{j5}(k)$
CS $\chi_{i6}(k)$	EC $\chi_{j6}(k)$
SA $\chi_{i7}(k)$	PC $\chi_{j7}(k)$

(3). GRA: Take the example of how training programs are connected with 'the communication/negotiation capability'

A. Since the primary data proved to have comparability, a GRA was conducted by using the *communication/negotiation capability* $\chi_{i1}(k)$ to represent the referential sequence and the *type of training program* to represent the comparative sequence.

B. The value of difference sequence was calculated using the formula of $\Delta_{ij}(k)=\left\|\chi_i(k)-\chi_j(k)\right\|$.

C. The formula in (2) was used to calculate the maximum and minimum values, which are 6.0 and 0.0, respectively.

D. Assumed the distinguishing coefficient $\zeta = 0.5$.

E. The grey relational coefficient was calculated using the formula:

$$\gamma(\chi_i(k),\ \chi_j(k))=(\Delta\min+\zeta\Delta\max)/(\Delta_{ij}(k)+\zeta\Delta\max)$$

F. Calculating the grey relational grade: since we assumed ($\beta = 1/8$), we learned that $\gamma(\chi_{\#1}\ \chi_{j1}) = 0.6515$, $\gamma(\chi_{\#1}\ \chi_{j2}) = 0.6228$, $\gamma(\chi_{\#1}\ \chi_{j3}) = 0.7750$, $\gamma(\chi_{\#1}\ \chi_{j4}) = 0.6442$, $\gamma(\chi_{\#1}\ \chi_{j5}) = 0.5234$, $\gamma(\chi_{\#1}\ \chi_{j6}) = 0.4092$ and $\gamma(\chi_{\#1}\ \chi_{j7}) = 0.6344$.

G. Prioritizing the grey relational sequences: $\gamma(\chi_{\#1}\ \chi_{j3}) = 0.7750 > \gamma(\chi_{\#1}\ \chi_{j1}) = 0.6515 > \gamma(\chi_{\#1}\ \chi_{j4}) = 0.6442 > \gamma(\chi_{\#1}\ \chi_{j7}) = 0.6344 > \gamma(\chi_{\#1}\ \chi_{j2}) = 0.6228 > \gamma(\chi_{\#1}\ \chi_{j5}) = 0.5234 > \gamma(\chi_{\#1}\ \chi_{j6}) = 0.4092$.

The types of training program wee then prioritized on the basis of their correlations with the *communication/negotiation capability*, from the highest degree of correlation to the lowest: problem-solving and analysis > interpersonal communication >perceptions of roles and duties> executability > team leadership > work instructions > motivation. The results are shown in Table 5.

Table 5 Prioritizing the Training Program Types According to Their Correlations with the Communication/Negotiation Capability

Type of training program (sub-factor)	CA (main factor)
PS	77.50%
RC	65.15%
RD	64.42%
PC	63.44%
TC	62.28%
WC	52.34%
EC	40.92%

Following that procedure, this study's findings are summarized in Table 6.

Table 6 Priority of Training Program Types by Management Competency

Indicators / Type of training program	CA	TA	RA	DA	DK	CS	SA
RC	65.15% (2)	66.56% (4)	70.98% (2)	56.88% (5)	53.94% (6)	62.60% (4)	59.73% (5)
TC	62.28% (5)	72.50% (1)	83.75% (1)	65.36% (3)	58.84% (4)	57.86% (5)	60.36% (4)
PS	77.50% (1)	69.69% (2)	51.13% (7)	78.13% (1)	58.54% (5)	40.33% (7)	47.02% (7)
RD	64.42% (3)	68.21% (3)	55.04% (6)	77.50% (2)	52.13% (7)	52.90% (6)	57.34% (6)
WC	52.34% (6)	55.04% (6)	70.98% (3)	56.07% (6)	64.69% (3)	71.25% (2)	80.63% (1)
EC	40.92% (7)	47.38% (7)	61.61% (5)	45.61% (7)	67.54% (2)	82.50% (1)	74.38% (2)
PC	63.44% (4)	65.09% (5)	63.13% (4)	62.54% (4)	70.36% (1)	65.31% (3)	66.34% (3)

In Table 6, the types of training-program types are prioritized in accordance with each specific management competency that low-level supervisors are required of, as stated below:

a. The training programs that enhance the *communication/negotiation capability* are prioritized as: problem-solving and analysis > interpersonal communication > perceptions of roles and duties > executability > team leadership > work instructions > motivation.
b. The training programs that enhance the *capability as a team leader* are prioritized as: team leadership> problem-solving and analysis > perceptions of roles and duties > interpersonal communication > executability > work instructions > motivation.
c. The training programs that enhance the *social-networking capability* are prioritized as: team leadership > interpersonal communication > work instructions > executability > motivation > perceptions of roles and duties, and problem-solving and analysis.
d. The training programs that enhance the *decision-making capability* are prioritized as: problem-solving and analysis > perceptions of roles and duties > team leadership > executability > interpersonal communication > work instructions > motivation.
e. The training programs that enhance the *Mold management intelligence* are prioritized as: executability > motivation > work instructions > team leadership > problem-solving and analysis > interpersonal communication > perceptions of roles and duties.
f. The training programs that enhance the *customer-service capability* are prioritized as:

motivation > work instructions > executability > interpersonal communication >team leadership > perceptions of roles and duties > problem-solving and analysis.

g. The training programs that enhance the *ability to maintain system flexibility* are prioritized as: work instructions > motivation > executability > team leadership > interpersonal communication > perceptions of roles and duties > problem-solving and analysis.

DISCUSSION

The rationality of indicators and training programs

Professional knowledge varies among different fields of the Mold industry, and so do the required competences and how training programs should be planned. To meet the requirements stemming from globalization and vertical integration in the Mold supply chain, Taiwanese Mold firms usually design and manufacture products domestically while accomplishing mass-production in China, Indonesia or Vietnam. As for a supervisor's management capabilities, the ability to offer management and guidance to multinational employees (Bird *et al.*, 2010) and cross-cultural management capabilities (Isenhour *et al.*, 2012) are at the core of a *team leader's capabilities*. From the "rationality of indicators" point of view, the survey outcome proved that the indicators fully cover the 7 management competences. Regarding the rationality of training-program types, it has been confirmed with expert consultation that companies are free to incorporate, according to its needs, various topics (e.g., production management, material management, project management, component control and personnel training) into the supervisor training program, hence the expandability.

GRA solves uncertainties in pairing competences and the training programs

The goodness-of-fit test has been adopted as a common statistical approach to examining the *fit*, or testing the consistency of the actually observed and expected/theoretical frequency. GRA is a further application of the Fit theory. When it comes to pairing competences with training programs, the GRA suggests an emphasis on refining process (Chang, 2013b) and thus meets the requirement proposed by Bretz & Judge (1994) that analysis methods should meet the needs of research subjects. The greatest difference between GRA and the conventional statistical methods lies in the fact that the former does not require a sizable sample to calculate how much two sequences of data are correlated (Chen *et al*., 2005). In an attempt to optimize the process of pairing the training programs and competences, GRA contributed to training effectiveness as it solves uncertainties in the connection between competences and training programs.

Making up for the lack of literature

Researchers trying to identify the best competency-program combinations would end up *solving new problems with outdated experiences* if they rely solely on expert consultation and draw inspiration from the experts' experiences. A significant number of quantitative studies were performed in conjunction with the qualitative expert consultation, as exemplified by Marzo-Navarro *et al*. (2009) and Vincent & Focht et al. (2009). In the present study, expert consultation is coupled with the GRA method in order to display the advantages of both qualitative and quantitative research approaches, to quickly obtain the optimal priority of

training programs, and also to effectively reduce the time spent on, and procedure for, pairing the competences and training programs. Results of this study complement research efforts of Marzo-Navarro *et al.* (2009) and Vincent and Focht (2009).

CONCLUSION

Technologies are evolving so quickly that low-level supervisors are forced to constantly update their management intelligence in order to maintain corporate competitiveness. To address the ambiguous relationship between management competences and training programs, this study's author examined low-level Mold company supervisors in Taiwan, using such methods as expert consultation, survey research and GRA to accomplish a research project aimed at identifying the optimal combination of competences and training programs. According to the findings, there are 7 indicators of management competences of low-level supervisors, which in turn have roughly 7 types of corresponding training programs. This study proves GRA an efficient solution to the ambiguous relationships between competences and training programs in a fast-changing corporate environment.

Contributions of this study are that it proved GRA an efficient tool to practice the FIT theory; it makes up for the lack of literature on training effectiveness; it identified the management competence indicators suitable for low-level Mold company supervisors, including their corresponding training programs; it prioritized the training programs for each specific competency expected of the employees, which in turn provides a foundation for planning on-the-job training curricula.

Theoretically speaking, results of this study suggest a "pairing" research approach that is applicable to finding the corresponding training programs for general, core and professional competences. As far as management practices are concerned, this study is focused on the Mold industry, where small- and medium-sized manufacturers are faced with fast-changing technologies. Therefore, any company that needs to change or increase its required competences can draw inspiration from the types of training programs laid out in this study, and then start planning/designing those programs. Regarding the research limitations, the difference in production practices among the subgroups of metal Mold, as well as the difference between small- and medium-sized Mold manufacturers, left this study focused on the *types*, but not *components*, of training programs.

REFERENCES

1. Amran, A., Khalid, S. N. A., Razak, D. A. and Haron, H. (2011), "Development of MBA with specialization in sustainable development", *International Journal of Sustainability in Higher Education*, Vol.11 No. 3, pp. 260-273.
2. Bird, A., Mendenhall, M., Stevens, M. J. and Oddou, G. (2010), "Defining the content domain of intercultural competence for global leaders", *Journal of Managerial Psychology*, Vol. 25 Iss: 8, pp. 810 – 828.
3. Bretz, R.D., and Judge, T.A. (1994), "Person-organization fit and the theory of work adjustment: implications for satisfaction, tenure, and career success", *Journal of Vocational Behaviour,* Vol. 44 No. 1, pp. 32-54.
4. Chang, C.C. (2012a), "Exploring IT entrepreneurs' dynamic capabilities using Q-technique", *Industrial Management & Data Systems*, Vol. 122 No. 8, pp. 1-18.

5. Chang, C.C. (2012b), "An integrated curriculum for developing students' employability", *World Transactions on Engineering and Technology Education,* Vol. 10 No.4, pp. 241-246.
6. Chang, C.C. (2013a), "An IPA-Embedded Model for Evaluating Creativity Curricula", *Innovations in Education and Teaching International, in Press.*
7. Chang, C.C. (2013b), "Quality improvement approach for reviewing the effectiveness of curricula", *Academic Research International,* Vol. 4 No.1, pp. 11-21.
8. Chang, M.H. and Chang, C.C. (2011), "Developmental model of strategic alliance for technological education", *International Journal of Engineering Education*, Vol.27 No.1, pp. 91-100.
9. Chen, S.H., Su, Y.M., Chung, C.C. and Huang, T.C. (2005), "Grey Relational Analysis of dried Roselle (Hibiscus Sabdariffal)", *Journal of Food Processing and Preservation*, Vol. 29 Iss: 3-4, pp. 228-245.
10. Danowitz, M. A., Hanappi-Egger, E., and Hofmann, R. (2009), "The development and implementation of a diversity management curriculum: Organizational change through exploration and exploitation", *International Journal of Educational Management*, Vol. 23 Iss: 7 pp. 590 – 603.
11. Dumas, A., and Hanchane, S. (2010),"How does job-training increase firm performance? The case of Morocco", *International Journal of Manpower,* Vol. 31 Iss:5, pp. 585-602.
12. Gashi, A. N., Pugh, G., and Adnett, N. (2010), "Technological change and employer-provided training: evidence from UK workplaces", *International Journal of Manpower*, Vol. 31 Iss: 4, pp. 426-448.
13. Holden, R., and Griggs, V. (2010), "Innovative practice in the teaching and learning of human resource development", *Journal of European Industrial Training*, Vol. 34 No.8/9, pp. 705-709
14. Isenhour, L.C., Stone, D.L. and Lien, D. (2012), "Advancing theory and research on employee behavior in China", *Journal of Managerial Psychology*, Vol. 27 Iss: 1, pp. 4-8.
15. Krueger, R.A., and Casey, M.A.(2000), *Focus Groups: A Practical guide for applied research (3rd),* Thousand Oaks, CA: Sage.
16. Lei, D., and Slocum, J.W. (1992), "Global strategy, competence-building and strategic alliances", *California Management Review*, Vol. 35 No.1, pp. 81-97.
17. Lin, Y., Ma, S., and Zhou, L. (2012), "Manufacturing strategies for time based competitive advantages", *Industrial Management & Data Systems*, Vol. 112 Iss:5, pp. 729-747.
18. Liu, G., Shah, R., and Schroeder, R. G. (2010), "Managing demand and supply uncertainties to achieve mass customization ability", *Journal of Manufacturing Technology Management*, Vol. 21 No. 8, pp. 990-1012.
19. Lyons, R. K. (2012), "Curriculum reform: getting more macro, and more micro", *Journal of Management Development,* Vol.31 No.4, pp. 412-423.
20. Marzo-Navarro, M., pedraja-Iglesias, M., and Rivera-Torres, P. (2009), "Curricular profile of university graduates versus business demands—is there a fit or mismatch in Spain?", *Education + Training*, Vol. 51 No. 1, pp. 56-69.
21. MOEA (2007). Industrial product group statistics. Availed at http://2k3dmz2.moea.gov.tw/gwweb/Default.aspx?menu=facnamelist (accessed 10 April 2013)
22. Noe, R. A. (2005), "*Employee training and development*", Singapore, McGRAW-HILL Companies, Inc.
23. Ojiako, U., Papadopoulos, T., Thumborisuthi, C., and Yang, Y. F. (2012), "Perception

variability for categorised risk factors", *Industrial Management & Data Systems*, Vol. 112 Iss: 4, pp. 600-618.
24. Öztaysi, B., Sezgin, S., and Özok, A. F.(2011), "A measurement tool for customer relationship management processes", *Industrial Management & Data Systems*, Vol. 111 Iss:6, pp. 943-960.
25. Palvia, P.C., King, R.C., Xia, W. and Palvia, S.C.J. (2010), "Capability,, quality, and performance of offshore IS vendors: a theoretical framework and empirical investigation", *Decision Sciences*, Vol. 41 No. 2, pp. 231-270.
26. Rae, D.(2007), "Connecting enterprise and graduate employability", *Education + Training*, Vol.49 No.8/9, pp. 605-619.
27. Rodwell, J. (2005), "The assessment of formal management development--A method, a baseline and the need to incorporate learning styles", *Journal of Management Development,* Vol. 24 No. 3, pp. 239-252.
28. Romer, P. M. (1986), "Increasing Returns and Long-Run Growth", *Journal of Political Economy*, Vol. 94, pp. 500-521.
29. Seethamraju, R. (2012), "Business process management: a missing link in business education", *Business Process Management Journal*, Vol. 18 No.3, pp. 532-547.
30. Teng, J. L. (2003), *The theory and application of gray system,* Taipei: Gao-li Publication Co.
31. Vincent, S., and Focht, W. (2009), "US higher education environmental program managers' perspectives on curriculum design and core competencies—Implications for sustainability as a guiding framework", *International Journal of Sustainability in Higher Education*, Vol. 10 No. 2, pp. 164-183.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

VALIDATING KNOWLEDGE/TECHNOLOGY EFFECTS TO OPERATIVE SUSTAINABLE COMPETITIVE ADVANTAGE

**Josu Takala, University of Vaasa, Department of production/Industrial management,
Po.box 700, FI-65101, Vaasa, Finland
Email: josu.takala@uwasa.f**

**Jari Koskinen, University of Vaasa, Department of production/Industrial management,
Po.box 700, FI-65101, Vaasa, Finland
Email: jari.koskinen@vacon.com**

**Yang Liu, University of Vaasa, Department of production/Industrial management,
Po.box 700, FI-65101, Vaasa, Finland
Email: yli@uva.fi**

**Mehmet Serif Tas, University of Vaasa, Department of production/Industrial management
Po.box 700, FI-65101, Vaasa, Finland
Email: mehmet.tas@student.uwasa.com**

**Matti Muhos University of Vaasa, Department of production/Industrial management
Po.box 700, FI-65101, Vaasa, Finland
Email: Matti.Muhos@oulu.fi**

ABSTRACT

***Purpose**: This paper aims to present a fresh idea on how to model and examine the level of sustainable competitive advantage (SCA) with and without knowledge/technology (K/T) effects in a case company's operation by taking the manufacturing strategy's development directions and the efficiency of resource allocation among its attributes into consideration.*

***Design/Methodology/approach**: In this paper, questionnaires are filled by two different managerial groups, company's global business directors (G1) and company's directors in global operation strategies (G2). The analyses based on G1, G2 and G1-G2 (mixed results) are performed and examined as well as the effect of knowledge/technology rankings to observe the differences on how they effect on company's operations strategy and what kind of a strategy type that decision makers might fallow. Besides, the effects of knowledge/technology rankings on SCA risk levels are examined on different case companies to perceive the similarities and differences with our case company. In this case study, the objectives are achieved based on several methodologies: manufacturing strategy index (MSI) (Takala, et al., 2007) and sense and respond (S&R) methodology (Liu, et al., 2011).*

***Findings**: The achieved results through the model are found to be promising corresponding to the feedback from the respondents.*

***Research limitations/implications**: The model is applied only in a medium sized B2B global company that produces power electronics products. Therefore, further tests need to be applied to the model in case of multiple companies from different sizes and areas to figure out the best formula in case of validation of strategic direction (MAPE, RSME or MAD).*

***Practical implications**: As a result of its wide applicability and its ease in arrangement the model has an enormous potential for strategic decision-making process and strategic analysis.*

***Originality/Value**: The model can provide a more dependable possibility of sustainable improvement to the corporate operational excellence and strategy.*

Keywords: Sustainable competitive advantage (SCA), knowledge/technology rankings, manufacturing strategy, sense and respond (S&R), operational excellence, operations management.

INTRODUCTION

The growing role of technology cannot be underestimated nowadays as it brings vast number of opportunities for business development, growth and strengthen of the competitive advantages (Takala, 2012). The advanced technology is the source of profit and competitiveness to enterprises, and at the same time, it is also an important support which helps enterprises adapt market changes. Along with the unceasing renovation of technology of industry, enterprises must continually adapt to the technical requirements of the market.

Although, SCA was not formally defined at the beginning it is first aroused by Porter (1985) that the firms of basic types of competitive strategies can be possessed of achieving SCA. Barney (1991) has made a closer definition by uttering as: "A firm is said to have a sustained competitive advantage when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors and when these other firms are unable to duplicate the benefits of this strategy (italics in original)" (p. 102). By the SCA values, one may observe how much the resource allocation supports the company's strategy. Liu states that the main idea lies behind the implementation of SCA is to find the critical attributes in resource allocation trough sense and respond methodology (S&R) and make the improvements that provides to perform dynamic adjustments to enhance the company's strategy in turn (2010).

The view of an organization based on the resource allocation is started by the theoretical reference basis of competitiveness in manufacturing operations (Wernerfelt, 1984). It is aimed to understand whether the right direction of development is selected to make certain that the selected strategy is followed by the corporation by employing resource allocation with dynamic capabilities' point of view. Accordingly, manufacturing strategy index (MSI) (Takala, et al., 2007) and the method of detection of a company's preferable strategy type through utilization of sense and respond (S&R) methodology (Liu, et al., 2011) methodologies are used for the validation.

In this paper, all the analyzes are performed based on 11 interviews with global business directors and directors in global operation strategies in a medium sized B2B global company that produces power electronics products. In its business area, the case company is one of the biggest players focusing on frequency converters.
In this paper, the analyses based on the level of SCA is modeled and examined with and without the effects of K/T in our case company's operation by involving MSI and S&R. Here, two research questions are aroused. First one is how to evaluate K/T effects to SCA and the second one is how valid different SCA models to evaluate K/T effects to SCA are in practice. In the literature review part, great background information is provided for the reader to have a good understanding of the process and in the following part, the required equations are given for the modeling of SCA. Subsequently, analyses are performed and the results are discussed and concluded.

LITERATURE REVIEW

1. Manufacturing strategy

Johnson describes strategy as 'the direction and scope of an organization over the long-term, which achieves advantage in a changing environment through its configuration of resources with the aim of fulfilling stakeholder expectations' (Johnson at al. 2005). Mintzberg states that strategy is organization's future plan, a position in specific markets, a pattern of its performance and a tactic to left behind its competitors (Mintzberg, et al., 1998).
Miles & Snow topology (1978) is a dominant framework of the strategy types. They have developed a comprehensive framework which states that the strategy type can be detected depending on the fixed proportions between RAL Model elements (Quality, Cost, Time/Delivery, and Flexibility). By this framework strategy types are considered to be four different groups, prospectors, defenders, analyzers and reactors. Decision makers stick to one of these strategies at certain times depending on the market condition to avoid crisis from turbulent business environment. Prospector strategy has a definite focus on quality and it endlessly seeks for new market opportunities, defender strategy aims achieving an advantage in cost to create a stable market share and analyzer strategy is considered to be an intermediate one as it focuses on balancing between quality, cost and time.

2. Strategy detection

Each attribute in the list (**Table 1**) is numbered and analyzed in graphs with respect to the order (**Figure 1**). In the last column (**Table 1**), the attributes from OP (Operations) questionnaire are assigned to one of the multiple key categories of RAL model Quality (Q), Cost (C), Time/Delivery (T) and Flexibility (F), depending on their most significant effect (Takala, 2012). These categorizations are performed to integrate Miles & Snow topology into Sense and Respond methodology. According to Thomas L. Saaty: "To make a decision we need to know the problem, the need and purpose of the decision, the criteria of the decision, their sub-criteria, stakeholders and groups affected and the alternative actions to take." (Saaty, 1980).

Table 1. The list of attributes used in Sense and Respond questionnaire

	ATTRIBUTES	
	Knowledge & Technology Management	
1	Training and development of the company's personnel	← Flexibility
2	Innovativeness and performance of research and development	← Cost
3	Communication between different departments and hierarchy levels	← Time
4	Adaptation to knowledge and technology	← Flexibility

5	Knowledge and technology diffusion	← Cost
6	Design and planning of the processes and products	← Time
	Processes & Work flows	
7	Short and prompt lead-times in order-fulfillment process	← Flexibility
8	Reduction of unprofitable time in processes	← Cost
9	On-time deliveries to customer	← Quality
10	Control and optimization of all types of inventories	← Quality
11	Adaptiveness of changes in demands and in order backlog	← Flexibility
	Organizational systems	
12	Leadership and management systems of the company	← Cost
13	Quality control of products, processes and operations	← Quality
14	Well defined responsibilities and tasks for each operation	← Flexibility
15	Utilizing different types of organizing systems	← Flexibility
16	Code of conduct and security of data and information	← Cost
	Information systems	
17	Information systems support the business processes	← Time
18	Visibility of information in information systems	← Time
19	Availability of information in information systems	← Time
20	Quality & reliability of information in information systems	← Quality
21	Usability and functionality of information systems	← Quality

3. Sense and respond

Sense and respond (S&R) is a comprehensively customizable industrial operational strategy to deal with current turbulent business environment. The main idea of 'Sense & Response' philosophy is the execution of the best practices in a turbulent business environment by detecting changes (sensing) and reacting to them properly (responding), in other words, converting threats into opportunities and drawbacks into strengths. Bradley and Nolan (1998) and Markides (2000) developed dynamic business strategies with respected to the S&R thinking. In case of facing frequently changing environmental conditions, companies are able to sense, adapt and rapidly respond due to these dynamic business strategies. The S&R was utilized by Ranta and Takala (2007) to develop the operative management system by introducing critical factor index (CFI). Since then, the S&R model has gone through three stages of development, which are called CFI model, BCFI model, and SCFI model (Liu, 2010).

4. Knowledge/Technology Rankings

Technology provides the opportunity of competitive advantage to a firm and decision makers should integrate this opportunity with their strategy (Marone, 1989). Knowledge/technology requirement section has been added to the Sense and Response questionnaire to gather information about the companies' knowledge/technology rankings. Respondents are required to evaluate each attribute in terms of basic, core and spearhead technologies in percentages while keeping the summation of these three terms to 100%.

Basic technology is referring to technologies commonly used and that can be purchased or outsourced while core technology is referring to company's current competitive technologies and spearhead technology is referring to the technologies focused on the future.
The importance of different technological levels (Basic, Core or Spearhead), in technology-based businesses, affects a lot the strategy implementation by the knowledge required, and supports the company's success in the competitive category chosen. The information is useful as it helps to understand additional ways of performance control and improvement for every listed attribute (Takala, 2012).

5. The method of Judgment on critical attributes

There are three different colors defined for the resource allocation of the attributes; red, yellow and green which represent whether an attribute is under resourced, over resourced or balanced. Here the resource allocation of the attributes is considered to be ideal if it is equally distributed. The whole resource is counted to be 100% and it is divided to the total number of attributes. By this division the average resource level is defined. An attribute is counted to be balanced and takes the green color if BCFI value is between the range of 1/3 and 2/3 of average resource level. For the rest, any attribute which has a lower BCFI value than 1/3 of average resource level is counted to be under resourced and takes the red color, and any attribute which has higher BCFI value than 2/3 of average resource level is counted to be over resourced and takes the yellow color (Liu et al, 2011).

6. Derivation of BCFI K/T

Right after applying the method of judging under resourced and over resourced attributes, the next step is to calculate the values of BCFI K/T for each attribute, depending on the formulas provided below (Table 2). First, the color of the attribute is taken into consideration then the dominating technology for that attribute. The dominating technology is one with a value more than 43%; in case all of the technology levels are less than 43% the one with the highest value is dominating (Takala, 2012).

Table 2. Technology Rankings: General formulas

	RED ATTRIBUTES	**YELLOW ATTRIBUTES**	**GREEN ATTRIBUTES**
Basic technology	**(B)CFI / (B% / 100)**	**(B)CFI * (B% / 100)**	**(B)CFI / (B% / 100)**
Core technology	**(B)CFI * (C% / 100)^2**	**(B)CFI / (C% / 100)**	**(B)CFI * (C% / 100)^2**
Spearhead technology	**(B)CFI * (SH% / 100)^3**	**(B)CFI / (SH% / 100)^2**	**(B)CFI * (SH% / 100)^3**

7. Oulu South Region (OEI)

Oulu South Area is located in Northern Ostrobothnia in the southern part of the province of Oulu. It has three sub-region area of cooperation. The area includes a total of 14 municipalities with a total population of just under 90 000, or about a quarter of the Northern Ostrobothnia population. In 2001, Oulu Southern Regional Ministry of the Interior approved the regional center program three sub-region network-type cooperation areas. The region's development strategy has been prepared in Oulu South 2015 agreement. The contract shall be entered in the main area of development in 2007-2015.

Oulu South is one of the main agricultural areas - the area can be characterized as an industrialized in rural areas, because the region offers a significant extent, the manufacturing industry jobs. The largest industries are agriculture, metals, wood products industry, and information and communication technology (ICT). The regional unemployment rate is among the lowest in northern Finland and the age structure of the population is young. This differentiates from other Finnish Oulu Southern rural areas. Oulu South is a business-friendly area where currently about 4,600 active companies. Of these, about 95% of companies are micro-enterprises. More than a hundred of enterprises with a range of less than 20 Oulu South map numbers of companies and municipalities is shown in following picture:

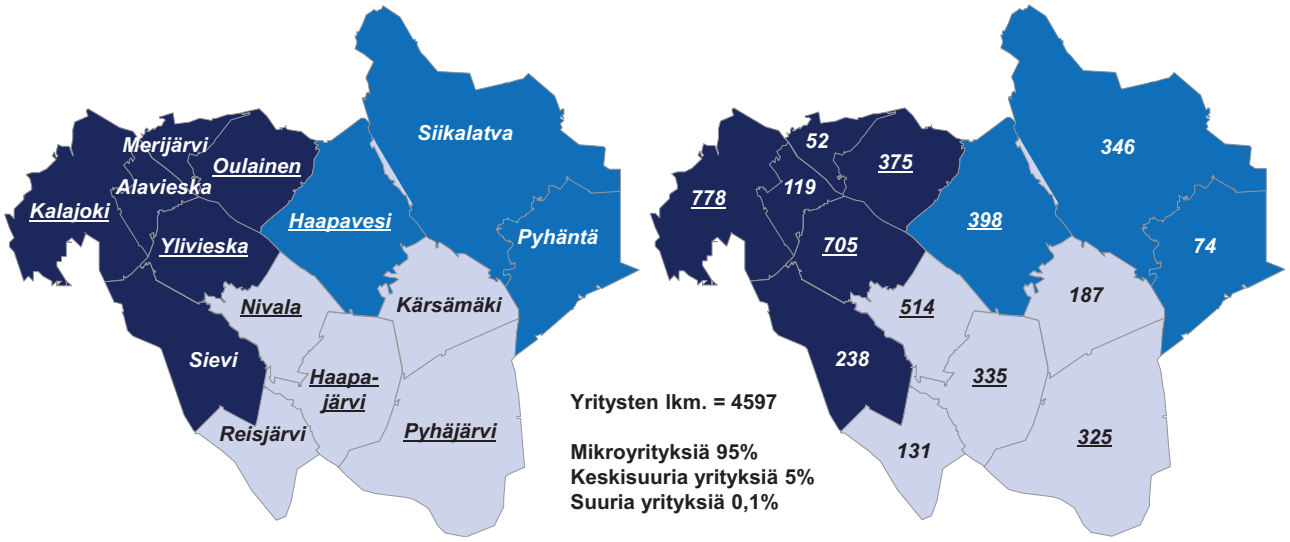


Figure 1. Oulu South municipalities and numbers of companies (Soliditet 2011)

THE IMPLEMENTATION OF SCA

For the calculation of the operational competitiveness rankings of the case companies in different groups, prospector, analyzer and defender, the analytical models are used for manufacturing strategy (MSI) (Miles & Snow, 1978). Takala states that the theory of analytical models are supported by the RAL (Responsiveness, Agility and Leanness) model by taking four main criteria into consideration, cost (C), quality (Q), time/delivery (T) and flexibility (F) (2002). The development of the analytical models is held from over 100 companies in the GMSS research group. Therefore, they have good transferability and they will provide competitiveness ranking of the case companies in this paper.

The equations below (1-4) stand for the calculations of normalized weights of four main criteria in the analytical models.

$$Q\% = \frac{Q}{Q + C + T} \tag{1}$$

$$C\% = \frac{C}{Q + C + T} \tag{2}$$

$$T\% = \frac{T}{Q + C + T} \tag{3}$$

$$F\% = \frac{F}{Q + C + T + F} \tag{4}$$

The equations (5-7) stand for the analytical models that provide the calculations of MSI of operational competitiveness in each group

The MSI model for prospector group:

$$\emptyset \sim 1 - \left(1 - Q\%^{\frac{1}{3}}\right)(1 - 0.9 * T\%)(1 - 0.9 * C\%) * F\%^{1/3} \tag{5}$$

The MSI model for analyzer group:

$$\lambda \sim 1 - (1 - F\%)[ABS[(0.95 * Q\% - 0.285) * (0.95 * T\% - 0.285) * (0.95 * C\% - 0.285)]]^{1/3} \tag{6}$$

The MSI model for defender group:

$$\varphi \sim 1 - \left(1 - C\%^{\frac{1}{3}}\right)(1 - 0.9 * T\%)(1 - 0.9 * Q\%) * F\%^{1/3} \tag{7}$$

Ranta and Takala (2007) have introduced critical factor index (CFI) into the operative management system to shape sense and respond (S&R) theory. By this way, the critical criteria of strategic adjustment that may support the strategic decision-making phase is interpreted and evaluated. The following model, BCFI, was developed by Nadler and Takala (2010) by taking the principle of CFI theory into consideration. Later, Liu, et al., (2011) developed the SCFI model that accurately models the S&R theory.

The following equations are used in the calculations of CFI, BCFI and SCFI models (8)-(11).

$$Importance\ index = \frac{Average\ of\ expectation}{10} \tag{8}$$

$$Gap\ index = \frac{Average\ of\ expectation - Average\ of\ experience}{10} - 1 \tag{9}$$

$$Development\ index = |(better - worse) * 0.9 - 1| \tag{10}$$

$$Performance\ index = \frac{Average\ of\ experience}{10} \tag{11}$$

The equations of CFI, BCFI and SCFI models are listed as follows:

$$CFI = \frac{std\{experience\} * std\{expectation\}}{Importance\ index * Gap\ index * Deelopment\ index} - 1 \tag{12}$$

$$SD\ expectation\ index = \frac{std\{expectation\}}{10} + 1 \tag{13}$$

$$SD\ experience\ index = \frac{std\{experience\}}{10} + 1 \tag{14}$$

$$BCFI = \frac{SD\ expectation\ index * SD\ experience\ index * Performance\ index}{Importance\ index * Gap\ index * Deelopment\ index} - 1 \tag{15}$$

$$SCFI = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(\text{experience(i)} - 1)^2} * \sqrt{\frac{1}{n}\sum_{i=1}^{n}(\text{expectation(i)} - 10)^2} * Performance\ index}{Importance\ index * Gap\ index * Deelopment\ index} \tag{16}$$

By the SCA values, one may observe how much the resource allocation supports the company's strategy. As the SCA value approaches to 1 the consistency between resource allocation and strategy becomes stronger.

MAPE (absolute percentage error):

$$SCA = 1 - \sum_{\alpha,\beta,\gamma}\left|\frac{BS - BR}{BS}\right| \tag{17}$$

RMSE (root means squared error):

$$SCA = 1 - \sqrt{\sum_{\alpha,\beta,\gamma}\left(\frac{BS - BR}{BS}\right)^2} \tag{18}$$

MAD (maximum deviation):

$$SCA = 1 - max_{\alpha,\beta,\gamma}\left|\frac{BS - BR}{BS}\right| \tag{19}$$

CASE STUDY

In this case study, MSI and S&R data are collected from a multinational Finnish company in two phases, 3 years in the past (P) and 3 years in the future (F). The collected S&R data is examined in three groups, G1, G2 and G1&G2, to analyze their distributed and normalized values in terms of quality, cost, time and flexibility as can be observed from the following tables. The values of the multiple key categories of RAL model (Q, C, T and F) are calculated separately based on CFIs values of the classified attributes (Table 1).

Table 3. Results of informants G1

	Quality	Cost	Time	Flexibility
CFI(P)	4,52	5,19	11,05	13,31
CFI(P) Normalized	0,13	0,15	0,32	0,39
CFI(F)	12,34	10,86	19,59	10,30
CFI(F) Normalized	0,23	0,20	0,37	0,19
BCFI(P)	4,82	4,75	5,88	9,66
BCFI(P) Normalized	0,19	0,19	0,23	0,38

	Quality	Cost	Time	Flexibility
BCFI(F)	15,22	9,08	9,19	9,95
BCFI(F) Normalized	0,35	0,21	0,21	0,23
SCFI(P)	61,37	78,01	105,72	192,53
SCFI(P) Normalized	0,14	0,18	0,24	0,44
SCFI(F)	174,24	140,76	148,54	174,76
SCFI(F) Normalized	0,27	0,22	0,23	0,27
BCFI TK(F)	15,50	5,94	13,98	17,34
BCFI TK(F) Normalized	0,29	0,11	0,27	0,33

Table 4. Results of informants G2

	Quality	Cost	Time	Flexibility
CFI(P)	9,16	13,38	9,15	10,21
CFI(P) Normalized	0,22	0,32	0,22	0,24
CFI(F)	12,72	15,95	13,64	14,29
CFI(F) Normalized	0,22	0,28	0,24	0,25
BCFI(P)	5,20	5,73	4,05	6,97
BCFI(P) Normalized	0,24	0,26	0,18	0,32
BCFI(F)	7,17	6,25	5,98	8,87
BCFI(F) Normalized	0,25	0,22	0,21	0,31
SCFI(P)	131,84	161,99	102,55	211,67
SCFI(P) Normalized	0,22	0,27	0,17	0,35
SCFI(F)	175,99	182,29	150,21	269,47
SCFI(F) Normalized	0,23	0,23	0,19	0,35
BCFI TK(F)	9,62	5,40	9,39	16,37
BCFI TK(F) Normalized	0,24	0,13	0,23	0,40

Table 5. Results of informants G1&G2

	Quality	Cost	Time	Flexibility
CFI(P)	8,47	11,28	11,92	13,30
CFI(P) Normalized	0,19	0,25	0,27	0,30
CFI(F)	13,97	15,48	18,37	17,40
CFI(F) Normalized	0,21	0,24	0,28	0,27
BCFI(P)	5,05	5,30	4,61	7,67
BCFI(P) Normalized	0,22	0,23	0,20	0,34
BCFI(F)	8,73	6,90	7,06	9,34
BCFI(F) Normalized	0,27	0,22	0,22	0,29
SCFI(P)	200,11	241,18	197,88	380,53
SCFI(P) Normalized	0,20	0,24	0,19	0,37
SCFI(F)	328,80	323,92	296,76	453,05
SCFI(F) Normalized	0,23	0,23	0,21	0,32
BCFI TK(F)	17,14	6,34	10,33	16,19
BCFI TK(F) Normalized	0,34	0,13	0,21	0,32

1. Results of K/T rankings from informants G1

Company's current competitive technologies (Core) seem to be around 35%, the technologies commonly used (Basic) differ from 25% to 50% and the technologies focused on the future

(Spearhead) is observed to be roughly around 20% in average (**Figure 2**). From the technology rankings point of view the company is found to be somehow competitive; however, spearhead ranking shows that company do not aim to invest on the technologies focused on the future.

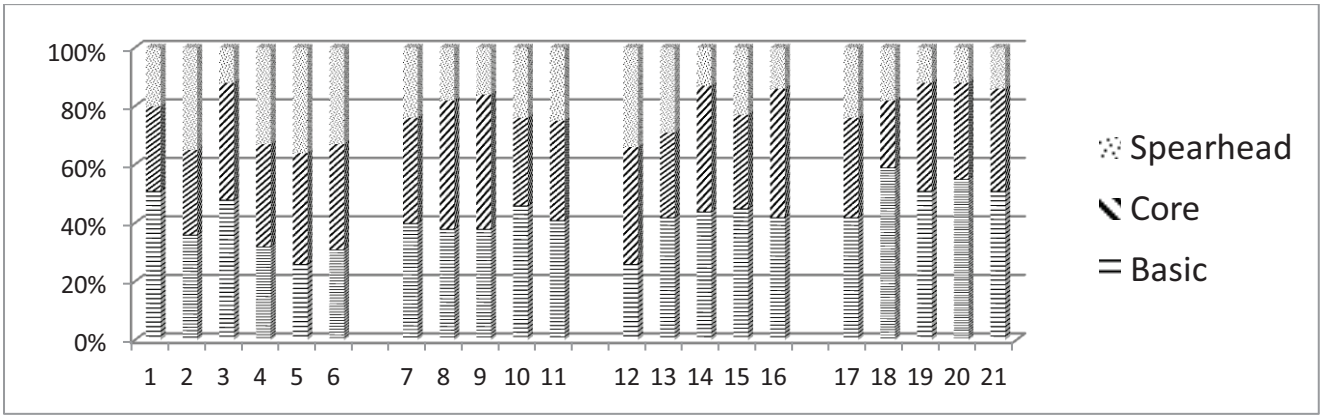


Figure 2. Knowledge/ Technology rankings

From the technology point of view, most of the attributes are going to be critical by lack of resource allocation and the attribute number 14 is going to be over resourced (**Figure 3**). Considering the K/T effects, it may be observed that while it enhances some attributes it makes it worse for others as the dominating technology ranking differs for attributes. Company may concentrate more on the right type of technologies for each attribute to keep them in balanced zone (3.17 – 6.35). Although, the overall situation is observed to be critical K/T effect has provide a positive impact in general.

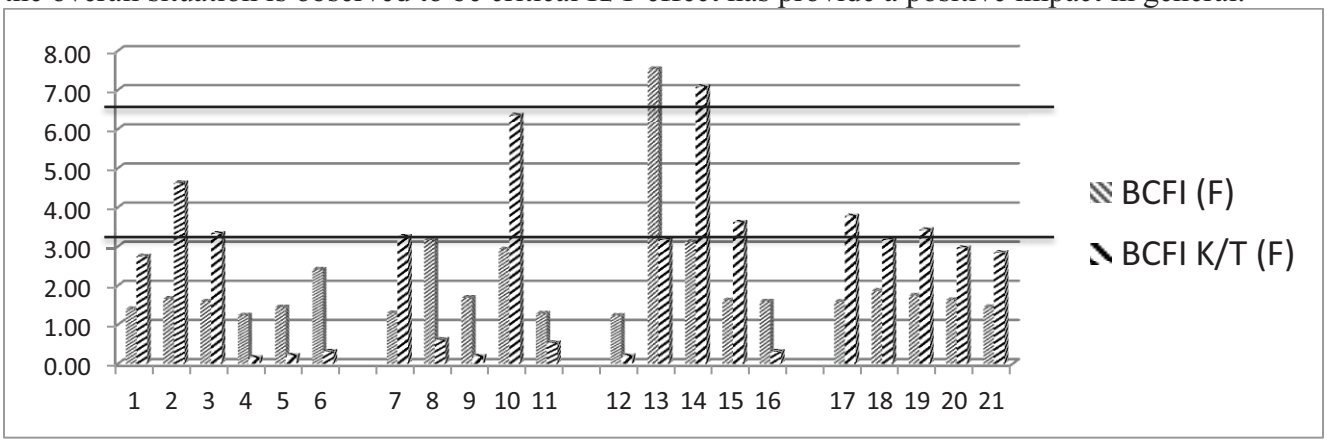


Figure 3. BCFI (F) vs BCFI K/T (F)

2. Results of K/T rankings from informants G2

Technology rankings for the attributes of G2 are seen to be slightly different compared to the answers from G1 (**Figure 2, Figure 4**). Here, participants from G2 values basic technologies more than spearhead technologies while they keep the core technologies in same level with G1. Although, there are small changes between G1 and G2 in technology rankings, the change in dominating technology will effect on the enhancement of the attributes by K/T effects.

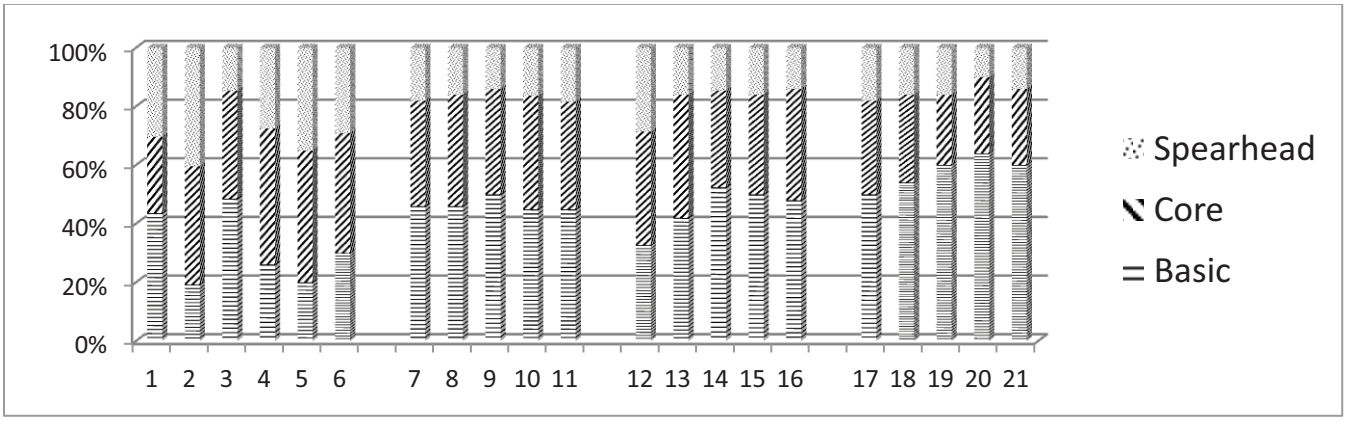


Figure 4. Knowledge/ Technology rankings

Except the attributes number 1, 11 and 14, all the attributes are going to be critical by lack of resource allocation from the technology point of view (**Figure 5**). The improvement done by K/T effects on BCFI in G1 is not observed well for the BCFI K/T values in G2 which means that K/T rankings consideration from G2 is not as effective as in G1 in general. Company should put more effort for under resourced attributes and decide on the right type of the dominating technology for each attribute.

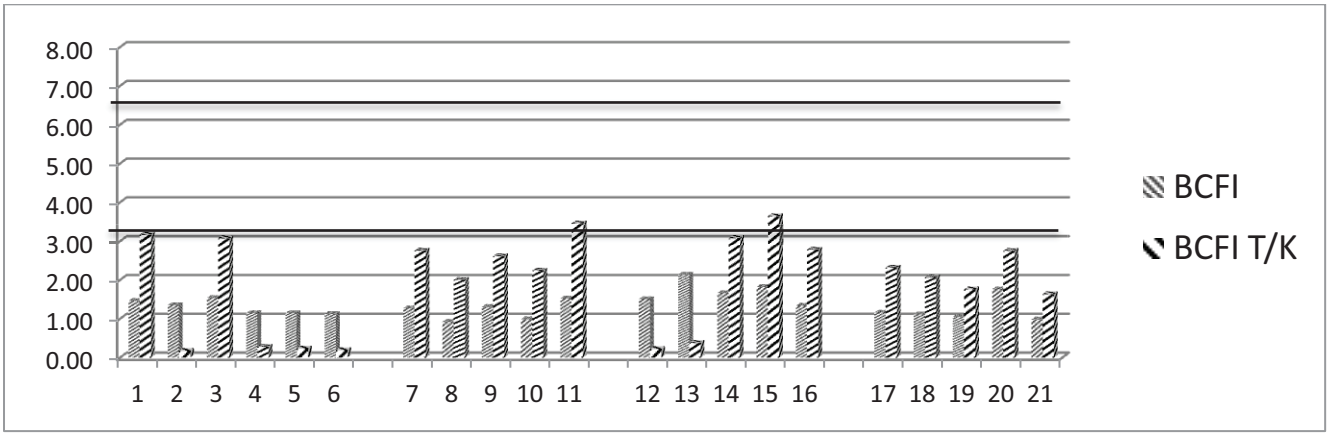


Figure 5. BCFI (F) vs BCFI K/T (F)

3. Results of K/T rankings from informants G1&G2

By analyzing the data from both groups' participants, company's core technologies seem to be around 35%, basic technologies differ from 25% to 60% and the technologies focused on the future (Spearhead) is observed to be roughly around 20% in average (**Figure 6**). It may be very clearly observed that the basic technologies are generally the dominating technology type for most of the attributes which implies that the company is not considered or going to be competitive from the technology point of view, although core technologies are around 35%.

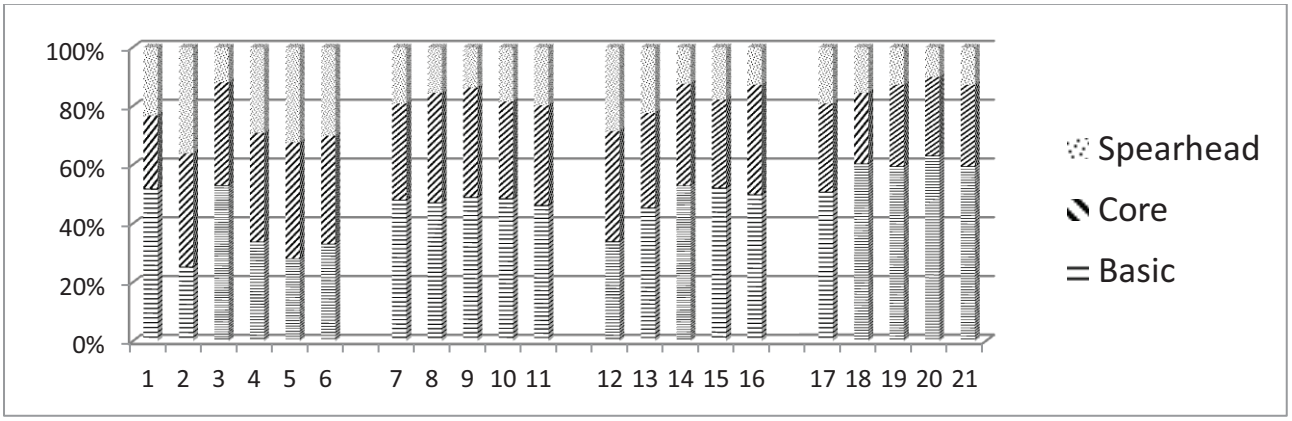


Figure 6. Knowledge/ Technology rankings

Except the attribute number 13, almost all the attributes are going to be critical by lack of resource allocation and the attribute number 13 is going to be over resourced with a small number (**Figure 7**). General situation in this figure does not seem a very bad one. Although, most of the attributes are not in the balanced zone they are quite near to be pulled to the balanced zone.

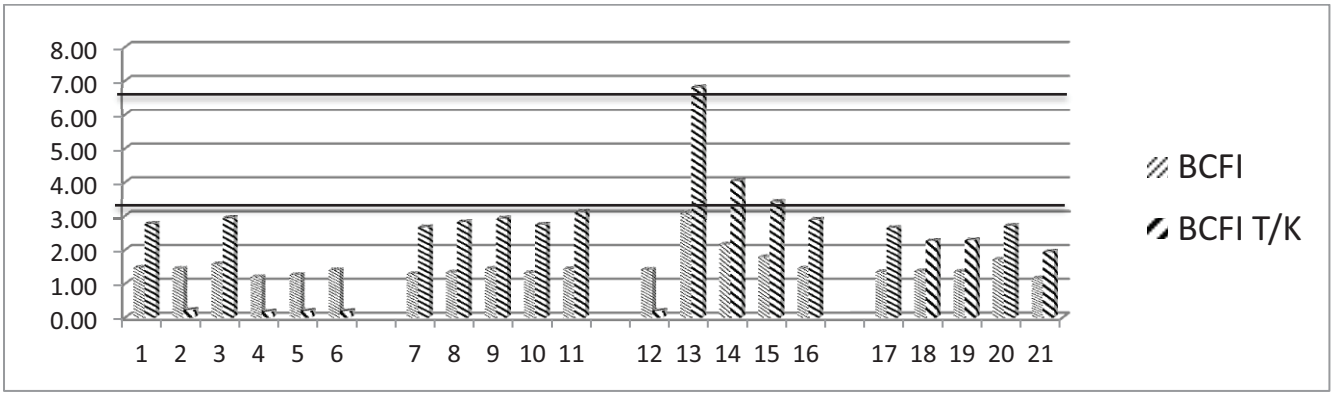


Figure 7. BCFI (F) vs BCFI K/T (F)

4. Strategy Type

Analyzer and defender strategy types are seen to be almost equally the most preferred strategy types for the company in the past case. Although, company aims to keep its operational strategy type unchanged analyzer strategy type is slightly less dominant for the future case but defender strategy type is the most dominant one (**Table 6**). It is well understood that the company is aiming to follow defender strategy type in the future case with and without K/T involvement; however, somehow it is also going to have analyzer strategy type characteristics as well in the future.

Table 6. Strategy type calculations.

	Prospector	Analyzer	Defender
G1 BCFI (P)	0,92	0,95	0,96

	Prospector	Analyzer	Defender
G1 BCFI (F)	0,78	0,87	0,89
G1 BCFI TK (F)	0,81	0,88	0,90
G2 BCFI (P)	0,95	0,97	0,97
G2 BCFI (F)	0,74	0,84	0,88
G2 BCFI TK (F)	0,77	0,86	0,89
G1-G2 BCFI (P)	0,94	0,96	0,97
G1-G2 BCFI (F)	0,74	0,84	0,88
G1-G2 BCFI TK (F)	0,76	0,86	0,89

5. SCA analyzes and Weak Market Test (WMT)

The calculated SCA values for the past case are seen to be relatively very high compared to the SCA values that are calculated for the future case (**Table 7**). In this scenario, it can be concluded that the resource allocation for attributes were partially supporting the operational strategy better; however, the resource allocation for the future scenario seems to be inadequate which means weak sustainability is unavoidable in the future operation strategies. Therefore, the decision makers are suggested to concentrate more on well distributed resource allocation between attributes.

Table 7. Calculated SCA results

	α	β	γ	MAPE	RMSE	MAD	WMT
G1 BCFI (P)	1,08	0,99	1,08	0,92	0,95	0,96	
G1 BCFI (F)	1,06	1,01	1,07	0,78	0,87	0,90	
G1 BCFI TK (F)	1,04	1,03	1,07	0,74	0,84	0,88	
G2 BCFI (P)	1,07	1,01	1,07	0,95	0,97	0,97	
G2 BCFI (F)	1,07	0,99	1,08	0,74	0,84	0,88	
G2 BCFI TK (F)	1,06	1,01	1,08	0,76	0,86	0,89	
G1-G2 BCFI (P)	1,07	0,99	1,07	0,94	0,96	0,97	0,94
G1-G2 BCFI (F)	1,07	0,99	1,08	0,74	0,84	0,88	
G1-G2 BCFI TK (F)	1,05	1,01	1,08	0,76	0,86	0,89	0,91

One other point observed from **Table 7** is the enhancement of K/T effects on SCA risk levels. Involving the K/T effect into the consideration shows a small improvement in SCA values for G2 and G1&G2 analyzes which simply indicates an automatic improvement in resource allocation. At this point it is highly suggested for the decision makers to adjust their technology rankings accordingly to improve the critically allocated resource for each attribute.

Validation of SCA formulas seem to work properly based on WMT. OEI case companies do not stand against the SCA risk levels; they approve the results with the practice. The same situation may be said for our case company, the practical SCA risk level is exactly same compared to MAPE and %2-3 higher risk level compared to RMSE and MAD in the past case. Although, there is a high risk level between WMT and MAPE the risk level is quite small in comparison of WMT and MAD in the future case. In this scenario, WMT data does not exactly fit to any of the SCA formulas. Therefore, there is a need to conduct more case studies to make a decision on which SCA formula would be more realistic.

6. K/T effects comparison with other OEI case companies

As the effects of K/T to SCA has also been examined for OEI case companies (OEI.1- OEI.7) a comparison between the results from these companies and our case company is performed. While the effect of K/T has a small enhancement, (1-3) %, to SCA values for our case company in case of G1&G2, it increases the risk level for the other OEI case companies except OEI.1 (**Figure 8**). The derived results imply that these companies cannot take the effect of K/T into account as they use weak or wrong type of the technology for most of their attributes.

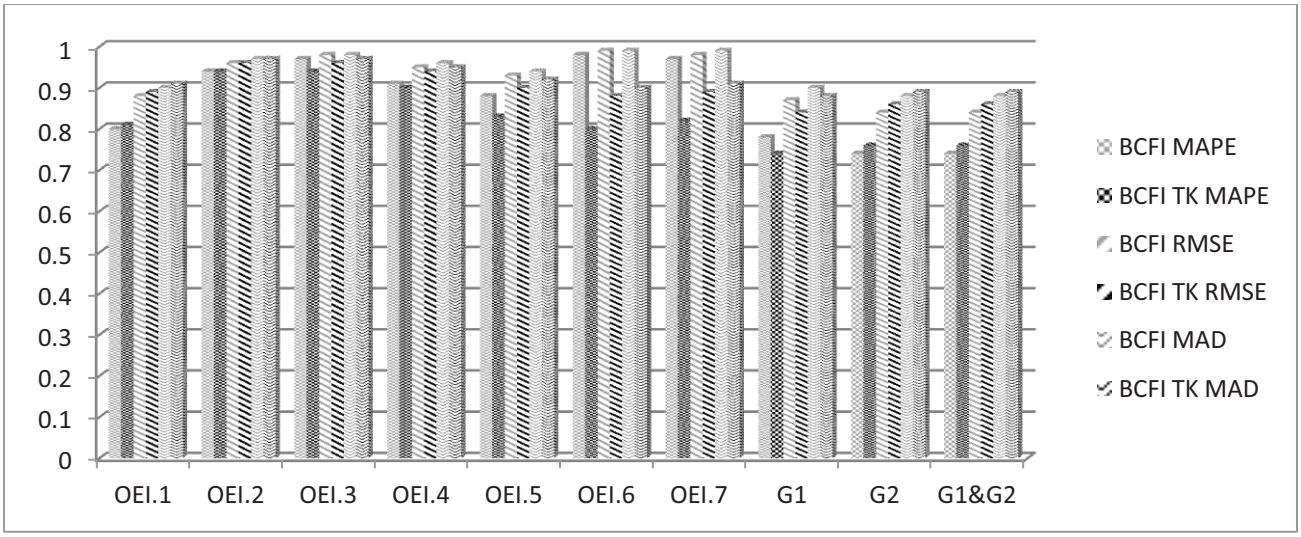


Figure 8. BCFI (F) vs BCFI K/T (F)

DISCUSSIONS

In this paper, the operations SCA evaluation may be considered as the risk probability. By achieving the SCA value, decision makers may decide on an operation strategy (among prospector, analyzer and defender operational strategy types) which causes least risk. The presented SCA method provides better sustainability, sensitivity and flexibility for the company. Moreover, it enhances its competitiveness and performance. The model provides possibility:

- To observe the right type of the operations strategies that may provide better performance for the company.
- To make the adjustments in case of the general strategy and take better strategic actions by operation with supplementary information.
- To investigate whether each unit in company follows the general strategy or not, in case of analyses for each unit separately. In case a unit is not following the general strategy, the attributes in that unit may be adjusted to converge with the company's general strategy.

Our international case company does not seem to be a competitive one in case of K/T rankings. Therefore, the enhancement of K/T to SCA values is not significantly seen in this study. The usage of the core technologies is around 35% and it might seem relatively sufficient; however, it is observed that the basic technology type is dominant for the most of the attributes. This situation shows that company is not planning to invest on the future type technologies efficiently.
Although. the model introduced in this paper provides an extensive potential and adequate practical value in case of strategic analyses and strategic decision making process it is found to be in need to

be tested with higher number of organizations in different type and size in order to find the best formula to validate the strategic decision (MAPE, RSME or MAP).

MANAGERIAL IMPLICATIONS

In this first validation that is based on WMT for OEI and our case companies, the models proposed for the calculation of K/T effects to SCA risk levels seem to work properly in practice.

CONCLUSION

The main role of this paper is to validate the effect of K/T to SCA in operations by taking the manufacturing strategy's development directions and the efficiency of resource allocation into consideration. In case study section, the analyses are performed and the recommendations are provided for the decision makers. Moreover, the analytical model presented in this paper could be considered as a great source to observe the weaknesses and strengths of the company's operations and accordingly to take required actions to keep up the sustainability of the company's development.

Although, the effect of K/T to SCA is observed to be significantly small the enhancement of K/T is not negligible in case of using right type of the dominating technology. K/T effects to SCA do not increase the risk levels and WMT is very close to the calculated SCA values in case of our case company. Therefore, K/T rankings model seems to be a valid one as it enhances resource allocation; however, more case studies need to be conducted to provide a stronger validation of K/T rankings and SCA models.

REFERENCES

1. Barney, J. (1991), "Firm Resources and Sustained Competitive Advantage." Journal of Management, Vol. 17 No. 1, pp. 99-120.
2. Johnson, G., Scholes, K. and Whittington, R. (2005), Exploring Corporate Strategy. Prentice Hall, Harlow, UK.
3. Liu, Y. (2010), "Implementing Sustainable Competitive Advantage for Proactive Operations in Global Turbulent Business Environments", available at: http://www.uva.fi/materiaali/pdf/isbn_978-952-476-314-1.pdf (accessed 15 February 2013).
4. Liu, Y., Wu, Q., Zhao, S. & Takala, J., (2011), "Operations Strategy Optimization Based on Developed Sense and
5. Respond Methodology", Proceedings of the 8th International Conference on Innovation & Management, Finland, 2011, University of Vaasa, pp. 1010-1015.
6. Mintzberg, H., Ahlstrand, B. W. & Lampel, J., (1998), "Strategy safari: A guided tour through the wilds of strategic management". http://cws.cengage.co.uk/barnes/students/sample_ch/ch2.pdf (accessed 10 March 2013).
7. Miles, R. & Snow, C., (1978), Organizational strategy, structure, and process. McGraw-Hill, New York, NY.
8. Morone, J. (1989), "Strategic Use of Technology", California Management Review, Vol. 31 No. 4, pp. 91-110.
9. Porter, M. E. (1985), Competitive Advantage: Creating and Sustaining Superior Performance, The Free Press, New York, NY.

10. Ranta, J-M. & Takala, J. (2007), "A Holistic Method for Finding Out Critical Features of Industry Maintenance Services", International Journal of Services and Standards, Vol. 3 No. 3, pp. 312-325.
11. Saaty, T.L. (1980), The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation, McGraw-Hill International Book Co., New York, NY.
12. Takala, J., (2012), "Resilient and Proactive Utilization of Opportunities and Uncertainties in Service Business", Proceedings of the University of Vaasa, Finland, 2012, University of Vaasa, Vaasa.
13. Takala, J., Kamdee, T., Hirvelä, J. & Kyllonen, S., (2007), "Analytic calculation of global operative competitiveness", Proceedings of the 16th International Conference on Management of Technology, Florida, 2012, International Association for Management of Technology, Orlando.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE ANTECEDENTS OF EXPATRIATES' CREATIVE ENGAGEMENT

Li-Yueh Lee, Kun Shan University, Taiwan
Email: wuleliyu@gmail.com

Veasna Sou, Institute of International Management, National Cheng Kung University, Taiwan
Email: souveasna76@yahoo.com

ABSTRACT

Purpose—*This study aims to examine the significance of cultural intelligence and cultural adjustment on expatriates' creative engagement. This study also extends relevant literature on expatriate management to examine the relationship between cultural intelligence, cultural adjustment, and expatriates' creative engagement through a mechanism taking into account the moderating roles of psychological climate.*
Design/methodology/approach—*The sample was collected from 328 Taiwanese expatriates working in Taiwanese MNC subsidiaries operating in China (Shanghai). Structural equation modeling in AMOS 21 and hierarchical regression (SPSS 19) were used to test six research hypotheses.*
Findings—*The SEM results indicate that cultural intelligence and cultural adjustment make significant contributions to expatriates' creative engagement. The results of a hierarchical regression analysis also confirm the moderating effects of the psychological climate. These findings suggest that cultural intelligence and psychological climate can play important roles as predictors of expatriates' creative engagement in cross-cultural environments.*
Research limitation/implications—*The main research limitations include the use of a cross-sectional research design using Taiwanese MNC subsidiaries in China as the sample and using self-reported questionnaires. Future studies can adopt a longitudinal research design or a case study to compliment the results of this study. This study focuses on the relationships between cultural intelligence, cultural adjustment, and expatriates' creative engagement through the moderating roles of psychological climate which have rarely been investigated. The findings of this study are also very important for academia and professionals in an expatriate context.*
Originality/value—*This study extends the theoretical model of cultural intelligence and psychological climate based on multiple perspectives of work-role transition, the principle of attribution, and social learning theories. Using a specific Chinese context, the current paper highlights the value and necessity of cross-cultural adjustment for successful expatriation.*

Keywords: cultural intelligence, cultural adjustment, creative engagement, psychological climate
Paper Type: Research paper

INTRODUCTION

Employee creativity has become a core competency, which helps organizations to sustain their competitive advantage (Chen, Li, and Tang, 2009). Employee creativity is of great significance to organizational effectiveness and survival (Pieterse, van Knippenberg, Schippers, and Stam, 2010). Most contemporary researchers and theorists have adopted a definition which can be described as the product or outcome of a development process (Shalley, Gilson, and Blum, 2009; Zhang and Bartol, 2010a). Creativity in the workplace is defined as being the production of novel and useful ideas or solutions in a given specific situation (Byron, Khazanchi, and Nazarian, 2010; George and Jones, 2012).

To date, most research on creativity has focused on creative performance, which refers to creative outcomes, i.e., the novel and useful ideas concerning products, services, or procedures which are ultimately produced (Shalley and Zhou, 2008; Zhang and Bartol, 2010a; Zhou and George, 2003). The present study focuses on creativity as an individual's ability to generate creative approaches to resolve problems (Hirst, Knippenberg, and Zhou, 2009). Although the consequences and antecedents of employee creativity have been well-documented by several recent studies in various local settings (Hirst *et al.*, 2009; Hon, 2011), expatriate creativity in cross-cultural settings has been largely ignored. Based on this rationale, creative engagement on the part of employees is related to the pro-active pursuit and learning of new ideas and approaches to improve individuals' achievement in the workplace (Zhang & Bartol, 2010a). In an expatriate context, expatriates' creative engagement can be defined simply as being the production of novel and useful ideas to resolve a problem, and as engagement which has the hallmarks of creative thinking and intelligent behavior.

With the growing diversity of multinational corporations (MNCs), which has resulted in their having a global presence, many modern MNCs may require or assign creative expatriates to deal with the core tasks which occur between the host and home companies (Rose and Kumar Subramaniam, 2008). The effectiveness of international assignments is of great significance to sustain organizational competitiveness, and firms may recruit expatriates who have a high degree of cultural awareness, including cultural intelligence and cultural adjustment, to enable them to effectively interact with people from different cultural backgrounds (Shannon and Begley, 2008). Such interaction seems to be difficult for expatriates and companies because cultural barriers often cause misunderstandings, which detract from efficient and effective interaction (Takeuchi, Tesluk, Yun, and Lepak, 2005). In a global context, interest in how MNCs compete when some individual expatriates deal with cultural diversity more effectively than others has gained increasing importance because of international assignments for expatriates (Shannon and Begley, 2008). Despite a growing amount of research on expatriate effectiveness in international assignments, which has included studies on expatriate performance (Kim, Kirkman, and Chen, 2008; Lee and Sukoco, 2010; Wu and Ang, 2011), there is still a lack of sufficient knowledge of the factors which influence expatriates' creative engagement.

Purposively, this present study extends the CQ and cultural adjustment literature proposed by Ang and Van Dyne (2008) in order to explore the role of CQ and its effects on cultural adjustment and expatriates' creative engagement, and also to determine how cultural adjustment

influences expatriates' creative engagement in cross-cultural environments. It also examines the moderating effects of the psychological climate in the influence of CQ on cultural adjustment and expatriates' creative engagement, and the influence of cultural adjustment on expatriates' creative engagement, respectively. It is posited that, when the psychological climate is positive, cultural intelligence will be high rather than low, and that it will be critical to cultural adjustment and expatriates' creative engagement. These research purposes are also elaborated in the research framework illustrated in Figure 1.

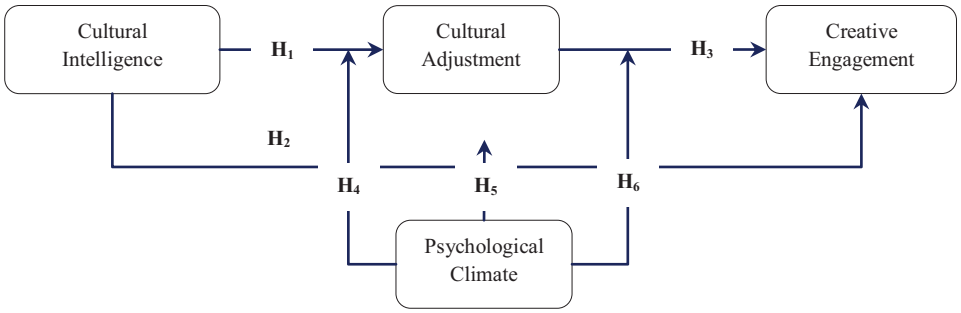


Figure 1: Influence of cultural intelligence on creative engagement

THEORETICAL FRAMEWORK AND HYPOTHESES

The influence of cultural intelligence on cultural adjustment

Cultural intelligence (CQ) plays an important role in developing cross-cultural relationships because individuals with high CQ tend to enjoy interacting with people from different cultural backgrounds (Chen, Lin, and Sawangpattanakul, 2011; Shannon and Begley, 2008). *CQ* is defined as being an individual's capability to identify or behave appropriately when adapting to new cultures (Ang *et al.*, 2007). According to Ang and Van Dyne (2008), CQ is composed of four factors (i.e., metacognitive CQ, cognitive CQ, motivational CQ, and behavioral CQ). CQ is proposed to be a key predictor of cultural adjustment, which can enable expatriates to be successful during international assignments (Kim *et al.*, 2008; Templer, Tay, and Chandrasekar, 2006). The rationale for the relationship between CQ and cultural adjustment can be explained by an attribution theory of achievement, motivation, and emotion (Weiner, 1985). The principle of attribution theory argues that individuals view ability as being a relatively stable emotion when dealing with a host cultural environment. This study argues that individuals who are able to identify, recognize, and reconcile cultural differences because of a higher level of CQ will better adjust to a new work environment and are more likely to be effective workers in the host country (Ang and Van Dyne, 2008; Kim *et al.*, 2008). Consequently, individuals with a high level of CQ are better able to effectively interact with people from a culturally-different society (Ang and Van Dyne, 2008), because it is likely that they gain more appropriate emotional satisfaction by interacting with local people (Kim *et al.*, 2008). This, in turn, is critical to their cultural adjustment. Based on the above discussion, the following hypothesis is proposed:
Hypothesis 1: Cultural intelligence has a positive influence on cultural adjustment.

The influence of cultural intelligence on expatriates' creative engagement

CQ literature demonstrates that expatriates with a strong sense of motivational CQ will facilitate cognitive processes and perform well in a variety of settings, such as those requiring high quality decision-making, goal-setting, and academic achievement, and will, in turn, achieve high levels of creative engagement (Bandura, Barbaranelli, Caprara, and Pastorelli, 2001; Luszczynska and Schwarzer, 2005). Metacognitive and cognitive CQ may influence expatriates to creatively engage in areas which require higher levels of culturally-related cognitive processing and more knowledge about the different cultural backgrounds which exist in the host country (Earley and Ang, 2003; Kim *et al.*, 2008). Behavioral CQ influences expatriates' creative engagement can be explained by social learning theory (Bandura, 1977), which suggests that individuals' interaction with other groups of people by learning about different cultural backgrounds (Tariques and Takeuchi, 2008) will influence their creative performance at work (Templer *et al.*, 2006). When expatriates understand the cultural differences in the host culture, they are more likely to effectively adapt to the new cultural setting (Chen *et al.*, 2011), which will then be likely to result in promoting a better performance in terms of their creative engagement. Therefore, this study argues that individual expatriates with a higher level of CQ will be better able to increase their generative, creative, proactive, and reactive ideas, which will lead to the effective completion of their international assignments. Based on this rationale, the following hypothesis is proposed:
Hypothesis 2: Cultural intelligence has a positive influence on expatriates' creative engagement.

The influence of cultural adjustment on expatriates' creative engagement

According to Vianen, Pater, Kristof-Brown, and Johnson (2004), cultural adjustment is conceptualized as being the degree of psychological comfort an expatriate has with various aspects of the host culture. Cultural adjustment has been primarily defined as being the degree of psychological comfort an expatriate feels in new cultural situations. In expatriation literature, Black and Stephens (1989) identify three facets of cultural adjustment, such as general adjustment—adjusting to housing, food, shopping, and other aspects of the foreigner culture, work adjustment—meeting job responsibility and performance expectations, and interactional adjustment—socializing and speaking with host-country nationals. The stronger expatriates' ability to engage in creative work, the more likely they are to become well-adjusted to a new cultural environment (Kraimer, Wayne, and Jaworski, 2001; Mol, Born, Willemsen, and Van Der Molen, 2005). It is argued that cultural adjustment may have an influence on individuals' creative engagement. Therefore, the following hypothesis is proposed:
Hypothesis 3: Cultural adjustment has a positive influence on expatriates' creative engagement.

The moderating effects of psychological climate

It was argued in the previous section that CQ influences cultural adjustment and expatriates' creative engagement, and that cultural adjustment influences expatriates' creative engagement, respectively. Further, it was suggested that these relationships may be qualified by expatriates' perception of the psychological climate in multi-cultural environments. This model applies the moderating effects of the psychological climate on the relationship between cultural intelligence, cultural adjustment, and creative engagement. In an unfamiliar or negative psychological climate,

expatriates may have less cognition about the motivation to adapt to the new cultural environment, and this may lead to negative work attitudes and outcomes, such as high turnover, job dissatisfaction, and poor performance (Parker *et al.*, 2003). The rationale of the psychological climate is addressed from the perspective of social cognitive theory (Bandura, 2001; James, Hater, Gent, and Bruni, 1978). Psychological climate is defined as expatriates' perception of the work environment in which their work behavior occurs based on their experience within an organization (James and Sells, 1981; Koys and DeCotiis, 1991).

A positive psychological climate is expected to provide a cognitive representation of expatriates' work environment which enables individuals to enhance an already high level of CQ and cultural adjustment. Expatriates with a high level of CQ and a positive psychological climate will better adjust to the new work environment in the host country, because it is likely that they will gain more emotional satisfaction by interacting with local people (Kim *et al.*, 2008). This study argues that, if individuals find a positive psychological climate in the host cultural environment, this may make the variance in expatriate CQ levels more important in relation to their adjustment and creative engagement in work. This situation may require expatriates to have a high level of CQ in order for them to adjust well and, in turn, enhance their creative engagement. Based on this rationale, the following hypotheses are proposed:

Hypothesis 4: The psychological climate moderates the relationship between cultural intelligence and cultural adjustment so that the relationship between CQ and cultural adjustment is stronger when the psychological climate is positive.

Hypothesis 5: The psychological climate moderates the relationship between cultural intelligence and expatriates' creative engagement so that the relationship between CQ and expatriates' creative engagement is stronger when the psychological climate is positive.

James et al. (2008) argue that the psychological climate is associated with employees' evaluation of different aspects of the work environment. When employees evaluate their work environment in a positive way, they tend to enhance their identification with their job and organization, and thus are more likely to display extra-role behavior which is beneficial for the organization for which they work (Wei, Han, and Hsu, 2010). Similarly, expatriates with a positive psychological climate may perceive that variances in cultural adjustment levels are more important in relation to expatriates' creative engagement. This situation will also require expatriates to have a high level of cultural adjustment so that they can engage more creatively at work. Based on this rationale, the following hypothesis is proposed:

Hypothesis 6: The psychological climate moderates the relationship between cultural adjustment and expatriates' creative engagement, so that the relationship between cultural adjustment and expatriates' creative engagement is stronger in a positive psychological climate.

METHODS

Samples and data collection

The sampling process involved two phases. Firstly, emails were sent to the human resource department of each home MNC to ask for the personal details of appropriate expatriates (i.e., Taiwanese expatriates in China) to participate in this study. A total of 68 MNCs responded. Secondly, a purposive sampling technique was adopted to send questionnaires to invite "three to four" expatriates in each department among 68 MNCs to participate in using an email-based survey. A total of 52 MNCs were collected, which included 344 expatriates from both departments. However, 16 questionnaires had to be excluded as outliers, and these were deleted using the graphic method, with a residual scatter plot in the range of ±3 standard deviation (Hair, Black, Babin, and Anderson, 2010). Finally, a total of 328 valid questionnaires from 48 MNCs were determined to be usable. The average number of expatriates in each department was 3.45, and the effective responsive rate was 35.55 percent.

Measures and variables

Cultural intelligence

The CQ self-report scale developed by Van Dyne, Ang, and Koh (2008) was adopted for the study. This consisted of a total of 20 items and four dimensions. All the items were measured on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree).

Cultural adjustment

Three sub-dimensions and 9 items of cultural adjustment adopted from Black (1988). All the items were measured on a 9-point sematic differential scale (-5= not adjusted at all; +5 = very well adjusted).

Creative engagement

Two factors and 8 items of creative engagement developed by Zhang and Bartol (2010b). All the items were measured on a 5-frequency scale (1= never, 2 = rarely, 3 = occasionally, 4 = frequently, and 5 = very frequently).

Psychological climate

Six items of the psychological climate developed by Wei, Han, and Hsu (2010) were adopted for this study. All the items were measured on a-5 point Likert scale (1 = strongly disagree; 5 = strongly agree).

The questionnaire items were translated from English to Chinese. A standard translation and back-translation procedure was performed to ensure the accuracy of the meaning of the measured

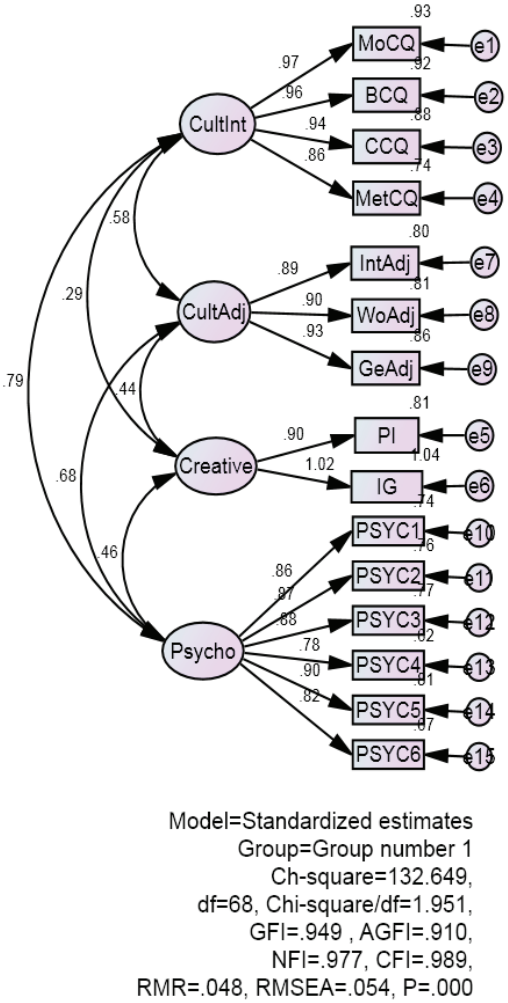
items. The details of questionnaire items and the Cronbach's alpha reliability are reported in the Appendix: Index items.

Confirmatory factor analysis (CFA)

A confirmatory factor analysis (CFA) was performed using AMOS 20 to evaluate the distinctiveness of the measures used in the present study. Anderson and Gerbing's (1988) research was adopted to assess the convergent and construct validity of the measurement model. CFA procedures have two order factor models (Koufteros, Babbar, and Kaighobadi, 2009). A first order-factor model was adopted to examine each individual research construct, and the results of this procedure indicated that the standardized loading for all items exceeded .70 and that the *t-values* were higher than 1.96 ($p < .05$), thus satisfying the threshold recommended by Hair *et al*. (2010) and Kline (2011). Then, a second-order factor CFA were conducted to examine the overall model fit of each construct. The results indicated that all research constructs were reliable and satisfied the threshold values, which exceeded .70.

Finally, the mean scores of the individual factors of each research construct (i.e., cultural intelligence, cultural adjustment, and expatriates' creative engagement) were computed to conduct the second order CFA in order to examine the overall appropriateness of the measurement model, as shown in Figure 2. The results showed that the overall goodness-of-fit assessment satisfied the threshold of $\chi^2 = 132.649$; df = 68; GFI = .949; AGFI = .910, and RMR = .048, thus indicating that the research model could be presented as a good model fit with adequate convergent validity and construct reliability (Gerbing and Anderson, 1992; Hair *et al.*, 2010).

The common method variance is adopted to validate inflated or deflated the strength of the relationship among the research constructs (Podsakoff, MacKenzie, Lee, and Podsakoff, 2003). To assess the potential impact of this form of bias in this study, discriminant validity was tested in three steps. Firstly, a Harman one-factor test was conducted (Podsakoff and Organ, 1986), which loaded all the variables into a principal component factor analysis. The results revealed that no single factor dominated (ten factors were generated with 82.5% of the total variance, with factor 1 only 28.89% of the variance). Secondly, convergent validity was demonstrated, since the average variance extracted (AVE) values for all constructs was higher than the suggested threshold value of .50 (Fornell and Larcker, 1981). Discriminant validity was determined by comparing the square root of the AVE with the Pearson's correlations among the constructs (see Table 1). All the AVE estimates can be seen to be greater than the corresponding inter-construct square correlation estimates in Table 2. Based on these results, it seems that common method bias is unlikely to be a problem with regard to the data (Gefen, Straub, and Boudreau, 2000).



Note: CultInt=Cultural intelligence; CulAdj= Cultural adjustment; Creative=Creative Engagement; Psychol=Psychological climate.

Figure 2 Second-order factor model (Overall model)

Table 1 Descriptive statistics and correlations among the research constructs (*N=328*).

Variable	Mean	Std. D	1	2	3	4	5	6	7	8	9	10	11	12
1.MetCQ	4.147	.878	**.913**											
2.CCQ	4.159	.924	.581**	**.956**										
3.BCQ	4.409	.781	.645**	.686**	**.919**									
4.MoCQ	4.364	.785	.646**	.688**	.636**	**.957**								
5.GeAdj	4.013	.783	.539**	.576**	.540**	.626**	**.945**							
6.WoAdj	3.625	.886	.581**	.551**	.509**	.486**	.411**	**.873**						
7.IntAdj	3.899	1.052	.620**	.554**	.533**	.542**	.424**	.509**	**.898**					
8.ProIde	4.460	0.790	.635**	.581**	.686**	.632**	.526**	.471**	.574**	**.92**				
9.IdeGen	4.463	0.764	.690**	.518**	.664**	.531**	.494**	.459**	.561**	.682**	**.955**			
10.PsyCli	3.768	1.451	.692**	.612**	.580**	.584**	.460**	.546**	.646**	.613**	.618**	**.939**		
11.LA	2.366	1.578	.188**	.128*	.137*	.073	.057	.073	.079	.094	.131*	.105	1	
12.Edu	2.564	1.050	.082	.082	.073	.057	.035	.073	.112*	.015	.083	.109*	.027	1

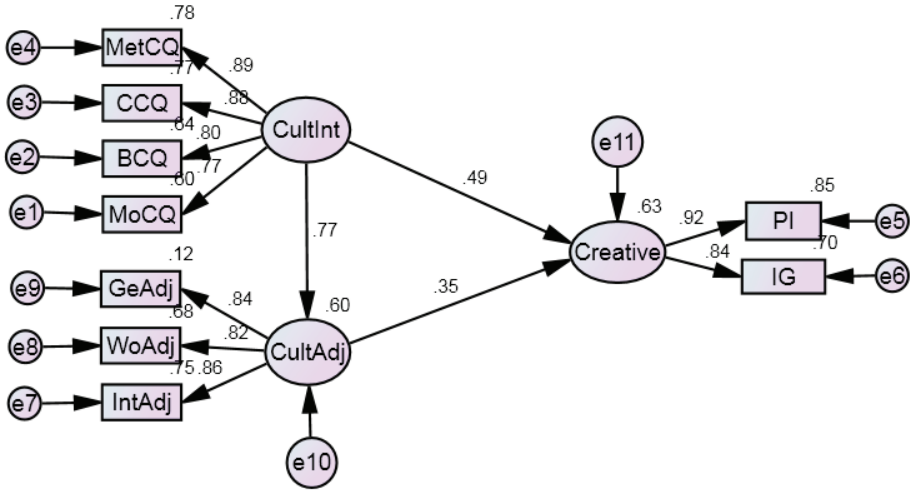
**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Internal consistency reliabilities appear as bold numbers along the diagonal. MetCQ=Metacognitive CQ; CCQ= Congnitive CQ; BCQ=Behavioral CQ; MoCQ=Motivational CQ; GeAdj=General adjustment; WoAdj=Work adjustment; IntAdj=Interactional adjustment; PI=Problem identification; IG=Idea generation; Psyc=Psychological climate; LA= Length of assignment; Edu=Education.

RESEARCH FINDINGS AND DISCUSSION

Structural equation modeling (SEM) was applied to test the maximum likelihood estimate method and Hypotheses 1-3. The results showed (see Table 3 & Figure 3) that χ^2/df = (28.009/15) = 1.867; GFI = .983; AGFI = .948, and p = .022, were satisfied with the threshold suggested by Hair *et al.* (2010). Hypothesis 1 predicted that cultural intelligence would have a positive impact on cultural adjustment. This finding provided support for Hypothesis 1 (β = .773; p <.001; *t-value* = 13.943). The results of this study confirmed the studies of Ang and Van Dyne (2008), Kim *et al*. (2008), and Templer *et al.* (2006). Hypothesis 2 predicted that cultural intelligence would have a positive impact on expatriates' creative engagement. The results provided support for Hypothesis 2 (β=.489; p < .001; *t-value* = 5.505). Similarly, this study also found that cultural adjustment had a significant and positive influence on expatriates' creative engagement (β=.353; p <.001; *t-value* = 3.745), which provided support for Hypothesis 3. The results also suggested that the relationship between cultural intelligence and creativity engagement was mediated by cultural adjustment, which was suggested by Sobel's (1982) test, which states that the mediating effect is significant if the *z-test* statistic is higher than the threshold value of *t-value* = 1.96. As shown in Table 4, the *z* score for cultural intelligence → cultural adjustment → expatriates' creative engagement; the *z-test* = 4.159 >1.96, which indicates that the mediating effect of cultural adjustment was significant for the influence of cultural intelligence on expatriates' creative engagement.



Model=Standardized estimates
Group=Group number 1
Ch-square=28.009,
df=15, Chi-square/df=1.867,
GFI=.983 , AGFI=.948,
NFI=.987, CFI=.994,
RMR=.015, RMSEA=.051, P=.022

Figure 3 Results of structural model (SEM)

Note: CultInt= Cultural intelligence; CultAdj= Cultural adjustment; Creative= Creative engagement MetCQ= Metacognitive CQ; CCQ= Cognitive CQ; BCQ= Behavioral CQ; MoCQ= Motivational CQ; GeAdj= General adjustment; WoAdj= Work adjustment; IntAdj= Interactional adjustment; PI= Problem identification; IG= Idea generation.

Table 2 Results of structural equation modeling (SEM).

Hypothesis	**Path**	**Direct effects**	**Indirect effects**	**Total effects**	***S.E***	***t-value***
Hypothesis 1	Cultural intelligence (CQ) →Cultural adjustment (CUA)	.773***			.062	13.943
Hypothesis 2	Cultural intelligence (CQ)→Expatriate creative engagement (ECE)	.489***			.080	5.505
Hypothesis 3	Cultural adjustment (CUA)→ Expatriate creative engagement (ECE)	.353***	.273***	.626***	.075	3.745
Sobel test[@]						
	CQ → CUA →ECE: ***z-test***= 4.159 > *t-value* = 1.96, (p<.001), a=.773, SE_a=.062, b=.353, SE_b=.080					
Fit indices						
Chi-square (χ^2)	= 28.009, *p*=.022					
df	= 15					
GFI	= .983					
AGFI	= .948					
NFI	= .987					
CFI	= .994					
RMR	= .015					
RMSEA	= .051					

Note: ***p<.001, **p<.01, *p<.05, and significant level at *t-value* >1.96; GIF = Goodness of Fit Index; AGFI = Adjusted Goodness of Fit Index; RMR = Root Mean Square Residual; NFI = Normed Fit Index; CFI = Comparative Fit Index; RMSEA= Root Mean Square Error of Approximation.

Table 2 provides a summary of the models and results used to test Hypotheses 4-6. Since cultural intelligence is measured by using continuous variables, the regression can be used to retain the continuous nature of the variables without losing information or reducing the power to detect the interactive effects (Aiken, West, and Reno, 1991; Cohen, Cohen, West, and Aiken, 2003). However, it is possible that variables may correlate with each other (high multicollinearity), and thus, the independent variables were mean-centered to reduce these effects (Frazier, Tix, and Barron, 2004). Then, a hierarchical regression was adopted to test the moderating effects of the psychological climate.

Table 3 The moderating role of psychological climate.

Independent variables	Dependent variables		
	Cultural adjustment	Expatriate creative engagement	
Main effects	Model-1 (H4)	Model-2 (H5)	Model-3 (H6)
Cultural intelligence (CQ)	.313*** (*t*=7.918)	.505*** (*t*=9.425)	-
Cultural adjustment (CUA)	-	-	.277*** (*t*=3.438)
Psychological climate (PSYC)	.264*** (*t*=5.290)	.350*** (*t*=4.667)	-
Interaction effects			
CQ x PSYC	.078** (*t*=2.738)	.131*** (*t*=3.374)	
CUA x PSYC	-	-	.166*** (*t*=3.546)
Control variables			
Length of assignment	.030 (*t*=1.159)	.009 (*t*=.241)	.057 (*t*=1.420)
Education	.002 (*t*=.066)	.023 (*t*=.649)	.026 (*t*=.648)
R^2	.784	.602	.487
ΔR^2	.005	.014	.020
ΔF	7.496	11.382	12.571
Sig. (p)	.007	.001	.000

*Note: *** p-value <.001; ** p-value <.01; * p-value <.05; significant level at t-value >1.96*

As shown in Table 3, the psychological climate has a direct effect on cultural adjustment (Model-1: β =.264; *t-value* = 5.290; p = .000) and expatriates' creative engagement (Model-2: β =.350; *t-value* = 4.667; p = .000). The results also revealed that the psychological climate moderates the influence of cultural intelligence on expatriates' creative engagement (Model-1: β =.078; *t-value* = 2.738; p = .007), which indicates support for Hypothesis 4. The psychological climate also moderates the relationship between cultural adjustment and expatriates' creative engagement (Model-2: β = .131; *t-value* = 3.374; p = .001), providing support for Hypothesis 5. Furthermore, the psychological climate was also found to moderate the relationship between cultural adjustment and expatriates' creative engagement (Model-3: β = .166; *t-value* = 3.546; p = .000), indicating support for Hypothesis 6. These moderating effects are also elaborated in Figures 4-6, respectively.

Following the procedures of Aiken *et al.* (1991) and Cohen *et al.* (2003), Figure 4 presents the moderating effect of the psychological climate and indicates that expatriates with a positive psychological climate ($\bar{Y}$ = 4.87) and higher cultural intelligence tend to achieve the highest level of cultural adjustment. Expatriates with higher cultural intelligence, but a negative psychological climate ($\bar{Y}$ = 4.35), tend to make less of a cultural adjustment. However, expatriates in a positive

psychological climate ($\bar{Y}$ = 3.894), but with lower cultural intelligence, tend to have the lowest levels of cultural adjustment. Those in a negative psychological climate with lower cultural intelligence also achieve a lower cultural adjustment. These results suggest that expatriates in a positive psychological climate can experience the highest levels of cultural adjustment in situations where they exhibit higher cultural intelligence. Thus, the above statements confirm Hypothesis 4.

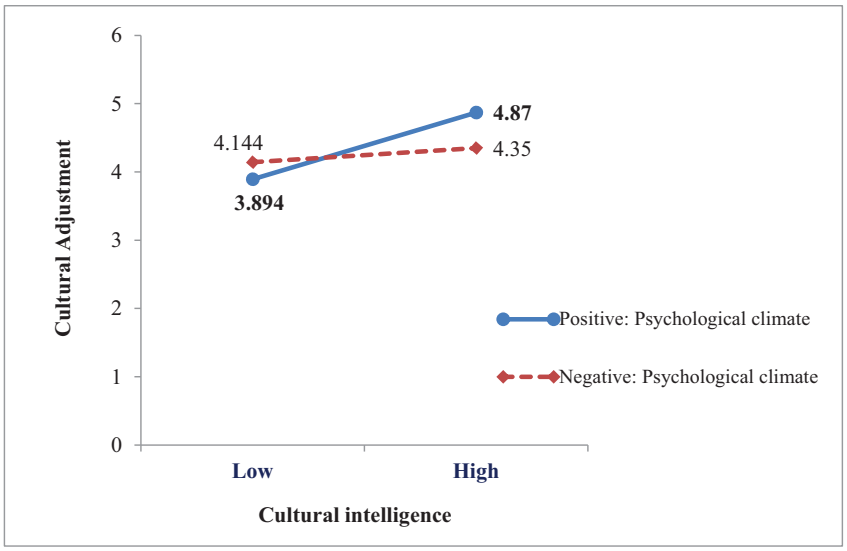


Figure 4. Hypothesis 4

Figure 5 indicates that expatriates in a positive psychological climate ($\bar{Y}$ = 4.251) and with higher cultural intelligence tend to achieve the highest level of creative engagement. As predicted, expatriates with higher cultural intelligence but in a negative psychological climate ($\bar{Y}$ = 4.088) tend to have lower creative engagement. However, expatriates in a positive psychological climate ($\bar{Y}$ = 3.191) but with lower cultural intelligence tend to have the lowest level of creative engagement. Those in a negative psychological climate and with lower cultural intelligence also achieve lower creative engagement. These results suggest that expatriates in a positive psychological climate can achieve the highest levels of creative engagement when they also have higher cultural intelligence. Thus, these statements provide support for Hypothesis 5.

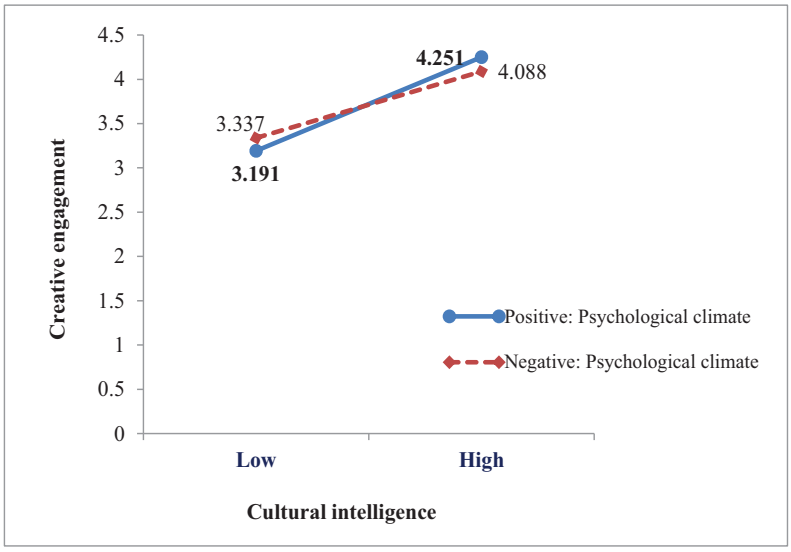


Figure 5. Hypothesis 5

Figure 6 presents the moderating role of the influence of the psychological climate on the relationship between cultural adjustment and expatriates' creative engagement. The results indicate that expatriates in a positive psychological climate ($\bar{Y} = 4.957$) and with a higher level of cultural adjustment tend to achieve the highest level of creative engagement. Expatriates with a higher level of cultural adjustment but in a negative psychological climate ($\bar{Y} = 4.616$) tend to have a lower level of creative engagement. However, expatriates in a positive psychological climate ($\bar{Y} = 4.09$) but with a lower level of cultural adjustment tend to have the lowest level of creative engagement. Those in a negative psychological climate and with a lower level of cultural adjustment also achieve a lower level of creative engagement. The results suggest that expatriates in a positive psychological climate can achieve the highest levels of creative engagement when combined with higher levels of cultural adjustment. Thus, the above rationales and discussions indicate support for Hypothesis 6.

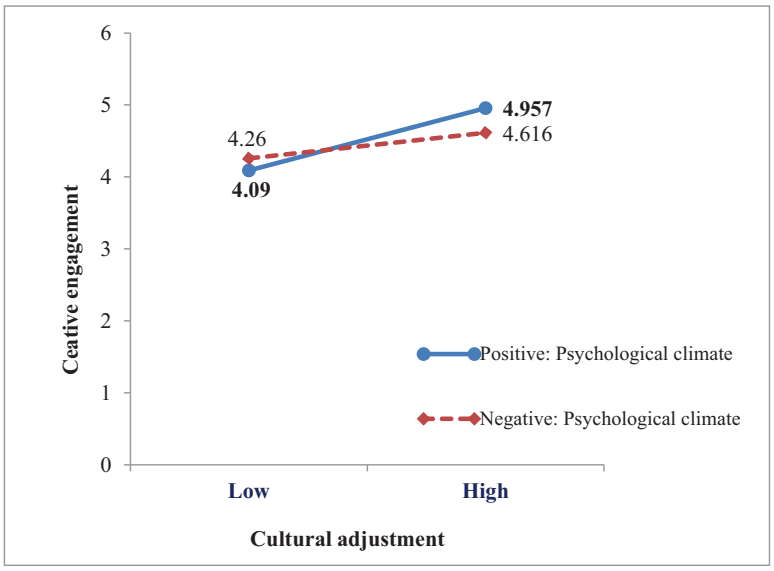


Figure 6. Hypothesis 6

RESEARCH IMPLICATIONS

The research findings of this study indicate that expatriate creativity also plays an important role in the effective performance of international assignments in 48 Taiwanese MNCs in China. Thus, the present study developed and tested a comprehensive model which encompassed the antecedents of expatriates' creative engagement in the context of an international assignment by integrating multiple social learning, social cognition, and work-role transition theories. It is critical to gain a better understanding of the factors which enable expatriates to perform effectively in cross-cultural environments (Kim *et al.*, 2008). The results indicated that all four dimensions of cultural intelligence (CQ) make a significant contribution to expatriate adjustment. This is in line with previous empirical findings, which have suggested that expatriates who are highly capable of interacting with different cultures will have a higher level of adjustment (Ang and Van Dyne, 2008; Kim *et al.*, 2008; Lee and Sukoco, 2010).

In particular, the results suggested that the relationship between CQ and expatriates' creative engagement was mediated by cultural adjustment. This was suggested by Sobel's test and was in line with Kim *et al.* (2008), who proposed that cultural adjustment plays an important role as a key mediator between cultural intelligence and expatriates' performance. Thus, it can be assumed that cultural adjustment plays an extremely critical role, having both a mediating and directing effect on the effectiveness of international assignments, including expatriates' performance (Kim *et al.*, 2008; Kraimer *et al.*, 2001; Lee and Sukoco, 2010) and expatriates' creative engagement.

Furthermore, the results of this study also indicated that the psychological climate can moderate the influence of the relationship among cultural intelligence, cultural adjustment, and expatriates' creative engagement. When the level of CQ is low, the psychological climate may lead to expatriates having a negative perception of their working environment, which results in lower

levels of cultural adjustment and creative engagement. In summary, this study suggested that expatriates who are more interested in experiencing diverse cultures, and are thus motivated to do so, will have more self-confidence in their ability to deal with new cultures, and in turn, will more effectively complete assignments. When expatriates exhibit a high capability with regard to cultural intelligence and the ability to overcome cultural differences, they are better able to work and interact with local co-workers, thus improving their ability to generate useful ideas and achieve better levels of performance. Empirically, the extension of cultural intelligence and the adjusted framework developed by previous studies to predict expatriates' creative engagement were also confirmed by this study. In addition, the overall prediction concerning the relationship among cultural intelligence, cultural adjustment, and expatriates' creative engagement was supported by social learning, social cognition, and work-role transition theories (Kim *et al.*, 2008; Takeuchi *et al.*, 2005). In addition to the expatriate context, the key antecedents of CQ may be important predictors of employees' work outcomes in service industries, such as hospitality and tourism. Because these industries require employees to interact with customers from diverse cultural backgrounds, employee CQ may influence customer satisfaction, and in turn, the performance and effectiveness of organizations (Kim *et al.*, 2008).

LIMITATIONS AND FUTURE RESEARCH

This study proposed that cultural intelligence influences cultural adjustment and expatriates' creative engagement by the mechanism of a psychological climate. It also discussed the moderating role of the psychological climate on the relationship among cultural intelligence, cultural adjustment, and expatriates' creative engagement. However, the study had some limitations which will provide interesting aspects for future research. Firstly, it focused on expatriates' creative engagement as a dependent variable, but future studies may need to include other indicators of international assignment effectiveness, such as job satisfaction, organizational commitment, and return intention. Secondly, it did not consider the effects of families' (or spouses') adjustment on expatriates' creative engagement. This topic should be addressed in future research because the existence of spouses and children can have a cross-over effect on expatriates' adjustment and creative engagement (Kim *et al.*, 2008; Takeuchi *et al.*, 2005). It is evidence to show that spousal adjustment influences cross-cultural adjustment and work-related outcomes (Shaffer and Harrison, 1998). Thus, future research should include the effects of family adjustment on the relationship among CQ, cultural adjustment, and creative engagement. Thirdly, cultural differences and cultural distance between host and home cultures should be included in the moderating effect among the relationship of CQ, cultural adjustment, and creative engagement (Kim *et al.*, 2008).

Finally, the sample in this study was predominantly Taiwanese expatriates, which focused on a Chinese context. It is suggested that future research should consider Chinese leadership styles (i.e., transformational and transactional leadership) because it is well known that leaders can influence the degree of role stress and uncertainty experienced by expatriates, which, in turn, may affect the level of cultural intelligence, cultural adjustment, and expatriates' creative engagement. Thus, future studies should test these variables in this study's model with samples from different populations. This may provide a greater insight into the phenomenon of expatriates' adjustment and creative engagement in cross-validation situations, such as Europe

versus Latin America or Asia versus Europe. These additional efforts will further enhance the validity and generalizability of the findings. In short, the research presented here contributes to an understanding of a CQ framework which can be integrated into an international assignment context.

REFERENCES

1. Aiken, L. S., West, S. G., and Reno, R. R. (1991), *Multiple regression: Testing and interpreting interactions,* Newbury Park: CA: Sage.
2. Anderson, J. C., and Gerbing, D. W. (1988), "Structural equation modeling in practice: A review and recommended two-step approach", *Psychological Bulletin,* Vol.103 No.3, pp. 411-423.
3. Ang, S., and Van Dyne, L. (2008), "Conceptualization of cultural intelligence: Definition, distinctiveness, and nomological network", In S. Ang and L. Van Dyne (Eds.), *Handbook of cultural intelligence: Theory, measurement, and applications*, Armonk, New York: M.E Sharpe, pp. 3-15.
4. Ang, S., Van Dyne, L., Koh, C., Ng, K. Y., Templer, K. J., Tay, C., and Chandrasekar, N. A. (2007), "Cultural intelligence: Its measurement and effects on cultural judgment and decision making, cultural adaptation and task performance", *Management and Organization Review,* Vol.3 No.3, pp. 335-371.
5. Bandura, A. (1977), *Social learning theory,* Englewood Cliffs, NJ: Prentice-Hall.
6. Bandura, A. (2001), "Social cognitive theory: An agentic perspective", *Annual Review of Psychology,* Vol.52 No.1, pp. 1-26.
7. Bandura, A., Barbaranelli, C., Caprara, G. V., and Pastorelli, C. (2001), "Self-efficacy beliefs as shapers of children's aspirations and career trajectories", *Child Development,* Vol.72 No.1, pp. 187-206.
8. Black, J. S. (1988), "Work role transitions: A study of American expatriate managers in Japan", *Journal of International Business Studies,* Vol.19 No.2, pp. 277-294.
9. Black, J. S., and Stephens, G. K. (1989), "The influence of the spouse on American expatriate adjustment and intent to stay in Pacific Rim overseas assignments", *Journal of Management,* Vol.15 No.4, pp. 529-544.
10. Byron, K., Khazanchi, S., and Nazarian, D. (2010), "The relationship between stressors and creativity: A meta-analysis examining competing theoretical model", *Journal of Applied Psychology,* Vol.95 No.1, pp. 201-212.
11. Chen, A. S.-y., Lin, Y.-c., and Sawangpattanakul, A. (2011), "The relationship between cultural intelligence and performance with the mediating effect of culture shock: A case from Philippine laborers in Taiwan", *International Journal of Intercultural Relations,* Vol.35 No.2, pp. 246-258.
12. Chen, C.-H., Li, H.-H., and Tang, Y.-Y. (2009), "Transformational leadership and creativity: exploring the mediating effects of creative thinking and intrinsic motivation", *International Journal of Management and Enterprise Development,* Vol.6 No.2, pp. 198-211.
13. Cohen, J., Cohen, P., West, S. G., and Aiken, L. S. (2003), *Applied multiple regression/correlation analysis for the behavioral sciences,* Mahwah, NJ: Erlbaum.
14. Earley, P. C., and Ang, S. H. (2003), *Cultural intelligence: Individual interactions across cultures.,* Standford, CA: Standford University Press.

15. Fornell, C., and Larcker, D. F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research,* Vol.18 No.1, pp. 39-50.
16. Frazier, P. A., Tix, A. P., and Barron, K. E. (2004), "Testing moderator and mediator effects in Counseling Psychology Research", *Journal of Counseling Psychology,* Vol.51 No.1, pp. 115–134.
17. Gefen, D., Straub, D. W., and Boudreau, M.-C. (2000), "Structural equation modeling and regression: Guidelines for research practice", *Communications of the Association for Information Systems,* Vol.4 No.7, pp. 2-76.
18. George, J. M., and Jones, G. R. (2012), *Understanding and managing organizational behavior,* New Jersey, NJ: Pearson Prentice Hall.
19. Gerbing, D. W., and Anderson, J. C. (1992), "Monte Carlo evaluations of goodness of fit indices for structural equation models", *Social Methods & Research* Vol.21, pp. 132-160.
20. Hair, J., Black, W., Babin, B. J., and Anderson, R. E. (2010), *Multivariate data analysis,* New Jersey Prentice Hall.
21. Hirst, G., Knippenberg, D. V., and Zhou, J. (2009), "A cross-level perspective on employee creativity: Goal orientation, team learning behavior, and individual creativity", *Academy of Management Journal,* Vol.52 No.2, pp. 280-293.
22. Hon, A. H. Y. (2011), "Enhancing employee creativity in the Chinese context: The mediating role of employee self-concordance", *International Journal of Hospitality Management,* Vol.30 No.2, pp. 375-384.
23. James, L. R., Choi, C. C., Ko, C.-H. E., McNeil, P. K., Minton, M. K., Wright, M. A., and Kim, K.-i. (2008), "Organizational and psychological climate: A review of theory and research", *European Journal of Work and Organizational Psychology,* Vol.17 No.1, pp. 5-32.
24. James, L. R., Hater, J. J., Gent, M. J., and Bruni, J. R. (1978), "Psychological climate: Implications from cognitive social learning theory and interactional psychology", *Personnel Psychology,* Vol.31 No.4, pp. 783-813.
25. James, L. R., and Sells, S. (1981), "Psychological climate: Theoretical perspectives and emperical research", In D. Mangussen (Ed.), *Toword a psychology of situation: An interactional perspective*, Hillsdale, NJ: Erlbaum, pp. 275-295.
26. Kim, K., Kirkman, B. L., and Chen, G. (2008), "Cultural intelligence and international assignment effectiveness: A conceptual model and preliminary findings", In S. Ang and L. Van Dyne (Eds.), *Handbook of cultural intelligence: Theory, measurement, and applications*, Armok, New York: M.E Sharpe, pp. 71-90.
27. Kline, R. B. (2011), *Principles and practice of structural equation modeling,* New York: Guilford Press.
28. Koufteros, X., Babbar, S., and Kaighobadi, M. (2009), "A paradigm for examining second-order factor models employing structural equation modeling", *International Journal of Production Economics,* Vol.120 No.2, pp. 633-652.
29. Koys, D. J., and DeCotiis, T. A. (1991), "Inductive measures of psychological climate", *Human Relations,* Vol.44 No.3, pp. 265-285.
30. Kraimer, M. L., Wayne, S. J., and Jaworski, R. A. A. (2001), "Sources of support and expatriate performance: The mediating role of expatriate adjustment", *Personnel Psychology,* Vol.54 No.1, pp. 71-99.

31. Lee, L.-Y., and Sukoco, B. M. (2010), "The effects of cultural intelligence on expatriate performance: The moderating effects of international experience", *International Journal of Human Resource Management,* Vol.21 No.7, pp. 963-981.
32. Luszczynska, A., and Schwarzer, R. (2005), "Social cognitive theory", In M. Conner and P. Norman (Eds.), *Predicting health behaviour: Research and practice with social cognition models* 2nd ed., New York: McGraw-Hill, pp. 127-169.
33. Mol, S. T., Born, M. P., Willemsen, M. E., and Van Der Molen, H. T. (2005), "Predicting expatriate job performance for selection purposes", *Journal of Cross-Cultural Psychology,* Vol.36 No.5, pp. 590-620.
34. Parker, C. P., Baltes, B. B., Young, S. A., Huff, J. W., Altmann, R. A., LaCost, H. A., and Roberts, J. E. (2003), "Relationships between psychological climate perceptions and work outcomes: A meta-analytic review", *Journal of Organizational Behavior,* Vol.24 No.4, pp. 389-416.
35. Pieterse, A. N., van Knippenberg, D., Schippers, M., and Stam, D. (2010), "Transformational and transactional leadership and innovative behavior: The moderating role of psychological empowerment", *Journal of Organizational Behavior,* Vol.31 No.4, pp. 609-623.
36. Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., and Podsakoff, N. P. (2003), "Common method biases in behavioral research: A critical review of the literature and recommended remedies", *Journal of Applied Psychology,* Vol.88 No.5, pp. 879-903.
37. Podsakoff, P. M., and Organ, D. W. (1986), "Self-reports in organizational research: Problems and prospects", *Journal of Management,* Vol.12 No.4, pp. 531-544.
38. Rose, R. C., and Kumar Subramaniam, N. (2008), "A review on individual differences and cultural intelligence", *Journal of International Social Research,* Vol.1 No.4, pp. 504-522.
39. Shaffer, M. A., and Harrison, D. A. (1998), "Expatriates' psychological withdrawal from international assignments: Work, non-work, and family influences", *Personnel Psychology,* Vol.51 No.1, pp. 87-118.
40. Shalley, C. E., Gilson, L. L., and Blum, T. C. (2009), "Interactive effects of growth need strength, work context, and job complexity on self-reported creative performance", *Academy of Management Journal* Vol.52 No.3, pp. 489-505.
41. Shalley, C. E., and Zhou, J. (2008), "Organizational creativity research: A historical overview", In J. Zhou and C. Shalley (Eds.), *Handbook of organizational creativity*, New York: Taylor and Francis, pp. 95-123.
42. Shannon, L. M., and Begley, T. M. (2008), "Antecedents of the four-factor model of cultural intelligence", In S. Ang and L. Van Dyne (Eds.), *Handbook of cultural intelligence: Theory, measurement, and applications*, Armok, New York: M.E Sharpe, pp. 41-55.
43. Sobel, M. E. (1982), "Asymptotic confidence intervals for indirect effects in structural equation models", *Sociological Methodology,* Vol.13 No.1982, pp. 290-312.
44. Takeuchi, R., Tesluk, P. E., Yun, S., and Lepak, D. P. (2005), "An integrative view of international experience", *Academy of Management Journal,* Vol.48 No.1, pp. 85-100.
45. Tariques, I., and Takeuchi, R. (2008), "Developing cultural intelligence: The roles of international nextwork experiences", In S. Ang and L. Van Dyne (Eds.), *Handbook of cultural intelligence: Theory, measurement, and applications*, Armonk, New York: M.E Sharpe, pp. 56-70.

46. Templer, K. J., Tay, C., and Chandrasekar, N. A. (2006), "Motivational cultural intelligence, realistic job preview, realistic living conditions preview, and cross-cultural adjustment", *Group & Organization Management,* Vol.31 No.1, pp. 154-173.
47. Van Dyne, L., Ang, S., and Koh, C. (2008), "Development and validation of the CQS: The cultural intelligence scale", In S. Ang and L. Van Dyne (Eds.), *Handbook of cultural intelligence: Theory, measurement, and application*, Armonk, New York: M.E Sharpe, pp. 17-38.
48. Vianen, A. E. M. V., Pater, I. E. D., Kristof-Brown, A. L., and Johnson, E. C. (2004), "Fitting in: surface- and deep-level cultural differences and expatriates' adjustment", *Academy of Management Journal,* Vol.47 No.5, pp. 697-709.
49. Wei, Y. C., Han, T. S., and Hsu, I. C. (2010), "High-performance HR practices and OCB: A cross-level investigation of a causal path", *International Journal of Human Resource Management,* Vol.21 No.10, pp. 1631-1648.
50. Weiner, B. (1985), "An attributional theory of achievement motivation and emotion", *Psychological Review,* Vol.92 No.4, pp. 548-573.
51. Wu, P.-C., and Ang, S. H. (2011), "The impact of expatriate supporting practices and cultural intelligence on cross-cultural adjustment and performance of expatriate in Singapore", *International Journal of Human Resource Management,* Vol.22 No.13, pp. 2683-2702.
52. Zhang, X., and Bartol, K. N. (2010a), "The Influence of creative process engagement on employee creative performance and overall job performance: A curvilinear assessment", *Journal of Applied Psychology,* Vol.95 No.5, pp. 862-873.
53. Zhang, X., and Bartol, K. N. (2010b), "Linking empowerment leadership and employee creativity: The influence of psychological empowerment, intrinsic motivation, and creative process engagement", *Academy of Management Journal,* Vol.53 No.1, pp. 107-128.
54. Zhou, J., and George, J. M. (2003), "Awakening employee creativity: The role of leader emotional intelligence", *Leadership Quarterly,* Vol.14 No.4-5, pp. 545-568.

Appendix: Index Items

Cultural intelligence (CQ)

Metacognitive CQ (α=.913; AVE=.844)

1. I am conscious of the cultural knowledge while I interact with other people from different cultural background (MetCQ1).
2. I adjust my cultural knowledge as I interact with people from a culture that is unfamiliar to me (MetCQ2).
3. I am conscious of the cultural knowledge I apply to cross-cultural interactions (MetCQ3).
4. I check the accuracy of my cultural knowledge as I interact with people from different cultures (MetCQ4).

Cognitive CQ (α=.956; AVE=.776)

1. I know the legal and economic systems of other cultures (CCQ1).
2. I know the rules (e.g., vocabulary, grammar) of other languages (CCQ2).
3. I know the cultural values and religious beliefs of other cultures CCQ3).
4. I know the marriage systems of other cultures (CCQ4).
5. I know the arts and crafts of other cultures (CCQ5).
6. I know the rules for expressing nonverbal behaviors in other cultures (CCQ6).

Motivational CQ (α=.919; AVE=.803)

1. I enjoy interacting with people from different cultures (MoCQ1).
2. I am confident that I can socialize with locals in a culture that is unfamiliar to me (MoCQ2).
3. I am sure I can deal with the stresses of adjusting to a culture that is new to me (MoCQ3).
4. I enjoy living in cultures that are unfamiliar to me (MoCQ4).
5. I am confident that I can get accustomed to the shopping conditions in a different culture (MoCQ5).

Behavioral CQ (α=.945; AVE=.782)

1. I change my verbal behavior (e.g., accent, tone) when a cross-cultural interaction requires it (BCQ1).
2. I use pause and silence differently to suit different cross-cultural situations (BCQ2).
3. I vary the rate of my speaking when a cross-cultural situation requires it (BCQ3).
4. I change my nonverbal behavior when a cross-cultural situation requires it (BCQ4).
5. I alter my facial expressions when a cross-cultural interaction requires it (BCQ5).

Cultural adjustment

General adjustment (α=.945; AVE=.782)

1. How adjusted are you to the food in foreign country? (GeAdj1)
2. How adjusted are you to shopping in foreign country? (GeAdj2)
3. How adjusted are you to the weather in foreign country? (GeAdj3)
4. How adjusted are you to generally living in foreign country? (GeAdj4)
5. How adjusted are you to the transportation system in host country? (GeAdj5)

Work adjustment (α=.873; AVE=.767)

1. How adjusted are you to your job and responsibilities? (WoAdj1)
2. How adjusted are you to working with local co-workers? (WoAdj2)

Interactional adjustment (α=.898; AVE=.821)

1. How adjusted are you to supervising foreigner subordinates? (IntAdj1)
2. How adjusted are you to working with your foreigner outside your company? (IntAdj2)

Creative Engagement

Problem identification (α=.920; AVE=.763)

1. I spend considerable time trying to understand the nature of the problem (PI1).
2. I think about the problem from multiple perspectives (PI2).
3. I decompose a difficult problem/assignment into parts to obtain greater understanding (PI3).

Idea generation (α=.955; AVE=.811)

1. I consider diverse sources of information in generating new ideas (IG1).
2. I look for connections with solutions used in seeming diverse areas (IG2).
3. I generate a significant number of alternatives to the same problem before I choose the final solution (IG3).
4. I try to devise potential solutions that move away from established ways of doing things (IG4).
5. I spend considerable time shifting through information that helps to generate new ideas (IG5).

Psychological climate *(α=.939; AVE=.679)*

1. My managers in this organization are easy to talk to about job-related problems (PSYC1).
2. My managers in this organization support subordinate delivery of new ideas (PSYC2).
3. Subordinates have effective channels to express their opinions' and 'superiors accept subordinates' suggestions and implement them (PSYC3).
4. My managers in this organization encourage subordinates to be creative (PSYC4).
5. My managers in this organization follow through on their commitments to subordinates (PSYC5).
6. My managers are quick to recognize good performance (PSYC6).

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

IMPLEMENTING BALANCED SCORECARD OF GOVERNMENT MIS DEPARTMENT－USING AHP AND FUZZY AHP METHODS

Yi-Hui Liang, Department of Information Management, I-Shou University, Taiwan (R.O.C.)
german@isu.edu.tw

ABSTRACT

The purpose of this study is to examine the role of the bal-anced scorecard in Government MIS Department. The frame of Government MIS Department performance applying the balanced scorecard methodol-ogy, analytic hierarchy process (AHP) and fuzzy AHP is developed by review the studies of balanced scorecard and information systems. Then, this study adopted 13 valid questionnaires in the Taiwan's Gov-ernment MIS Department to test the framework of the balanced scorecard. This study only adopts the Taiwan's Government MIS Department to vali-date the proposed measurement system. Future studies may aim other industries to evaluate Government MIS Department.

Keywords: Fuzzy theory, AHP, Balanced scorecard

INTRODUCTION

Since Executive Yuan, Republic of China implemented performance reward and performance management plan in 2003, this plan followed the Balanced Scorecard (BSC) spirit. However, Executive Yuan then consider the business properties, organi-zational culture, and management and check, so as to authorize each government department to set up its own performance evaluation process and evaluation indicators [1]。Until now, Executive Yuan does not force government departments to set up their own performance evaluation process and evaluation indicators [2].

Performance appraisal system is the most effective tool used for government reengineering. Performance appraisal aims to help people achieve their strategies, missions, visions and goals. Wu (2000)[3] supposed that good performance appraisal systems can enable government departments to allocate reasonable resources, priori-tize resource investment, further improve departmental effectiveness and efficiency, and organizational members adopt identical methods to pursue their goals, encourage their morale, and cause them to focus on organizational vision.
Balanced Scorecard (BSC), which was developed by Kaplan & Norton [4] in 1992, is a useful and popular method of identifying business performance using lag-ging and leading indicators based on the foundation of visions and strategies. Bal-anced Scorecard implies that organizational performance is evaluated not only utiliz-ing financial indicators, but also simultaneously non-financial indicators.

Satty's (1980) [5] analytical hierarchy process (AHP), which is a multi-criteria technique, is considered appropriate for solving complex decision problems [6]. The AHP is utilized in two manners with BSC: (1) choosing metrics at the beginning of the process and (2) understanding the relative importance of the metrics to a firm's managers and employees [7]. Clinton *et al.* (2002) [7] supposed the AHP is a single method that offers a means of selecting proper metrics, and this method is capable to satisfy each requirement of metric choice and scorecard construction. The AHP is based on theory and offers information on the relative weight of the BSC performance indicator [8][9].

Zadeh (1965) [10] developed fuzzy theory for handling problems involving fuzz-iness and vagueness. Lee *et al.* (2010) [11] posited that traditional BSC failed to con-solidate diverse performance indicators. Lee *et al.* (2010) [11] also suggested the fuzzy AHP method as a solution to this problem.

BSC can help managers of government organizations holistically evaluate infor-mation technology (IT) investments, as well as the performance of information sys-tem (IS) departments. This study builds a Framework for evaluating government MIS departments based on BSC. The study summarizes how to combine the BSC and fuzzy AHP to serve as a decision tool for government organization. The tool can be used not only to assess the contribution of a specific government MIS department, but also analyze the performance and direct the activities of government MIS depart-ments.

METHODOLOGY

1. Balanced Scorecard

Current strategic management suggests that there should be a strong linkage be-tween strategic plans and performance measures. Kaplan and Norton (1992)'s work [4] and determinants framework can provide this linkage. Kaplan and Norton (1992) [4] developed BSC to reform the traditional management system and as a means to evaluate corporate performance from four different perspectives, including financial, customer, internal business process and learning and growth, to measure performance. BSC suggests that systems for evaluating business performance should not only con-sider financial lagging indicators, but also customer, internal business process and learning and growth leading indicators.

Kaplan and Norton (1996) [12] indicated that BSC objectives and indicators based on vision and strategies can maintain a balance between short and long term objec-tives, financial and non-financial measures, lagging and leading indicators, and inter-nal and external performance perspectives. Kaplan and Norton (2004) [13] suggested strategy maps as a main means of describing and communicating strategies. Strategy maps clarify how to convert intangible assets, such as intangible activities contrib-uting to learning and growth, to improve organizational processes, increase customer satisfaction, and obtain better tangible outcomes, such as return on investment.

2. Research Structure and Select research variables

This study builds a Framework for evaluating government MIS departments based on BSC, AHP and fuzzy AHP.

This study adopted the dimensions and indicators which developed by Martinsons et al. (1999) [14], Liang, Hsieh, and Wang (2008)[15], and related government MIS experts to develop my proposed the dimensions and indicators. The research varia-bles are showed as Table 1.

Table 1. Research Variables

Dimension		Indicator	
Use orien-tation	1.	Build and maintain the good image and reputation with end users.	A1
	2.	Have the opportunity to develop IT.	A2
	3.	Maintain a good relation with user communities.	A3
	4.	Satisfy end user requirement	A4
	5.	Perceived the preferred IS products and services provider by end users.	A5
Business value	1.	Manage the good image and reputation.	B1
	2.	Make sure IS projects to offer business value.	B2
	3.	Control cost.	B3
	4.	Be onerous to offer the suitable IS products and services to the third party.	B4
Inner pro-cess	1.	Expect and affect the demands from end users and managers.	C1
	2.	Plan and develop IT efficiently.	C2
	3.	Operate and maintain IT applications efficiently.	C3
	4.	Obtain and test new hardware and software.	C4
	5.	Offer to satisfy the end user trainings with effective cost.	C5
	6.	Manage the IS problems effectively.	C6
Future readiness	1.	Expect and prepare the IS problems.	D1
	2.	Train and develop regularly to improve IS skills.	D2
	3.	Promote regularly IS applications mix.	D3
	4.	Increase regularly IS hardware and software.	D4
	5.	Implement cost-effective and new technological research-es which are suitable for organizations.	D5

3. The AHP and Fuzzy AHP methods

Saaty (1980) [5] developed the AHP method to resolve problems regarding choice and weight prioritization encountered during Multiple-Criteria Decision Making. The AHP method utilizes the pairwise comparison of alternatives to combine each deci-sion-maker evaluation into a final decision [11]. Zadeh (1965) [10] introduced fuzzy theory to address the vagueness of human thinking, which was oriented to the ration-ality of uncertainty

because of imprecision or fuzziness. Many studies have combined fuzzy theory with the AHP to compensate for problems introduced because of vague-ness [11][16].

The analytical steps of the AHP and fuzzy AHP methods for implementing balanced scorecard of Government MIS Departmentare showed as followings.

First, the analytical steps of the AHP method are illustrated as followings.

Step 1: Construct hierarchical framework of the BSC performance evaluation criteria

Step 2: Built pairwise comparison matrix A

Step 3: Using AHP method to calculate the weight

If get the weightmatrix W in pairwise comparison matrix A, standardize geomet-rical mean of row vectors, multiply element in every row, get geometrical mean and normalize it.

Step 4: Consistency Check

Second, the analytical steps of the fuzzy AHP method are illustrated as follow-ings.

Step 1: Construct hierarchical framework of the BSC performance evaluation criteria

From the four BSC perspectives, the hierarchical framework of the BSC perfor-mance evaluation criteria is constructed.

Step 2: Using AHP method to calculate the weight

If get the weightmatrix W in pairwise comparison matrix A, standardize geomet-rical mean of row vectors, multiply element in every row, get geometrical mean and normalize it.

Step 3: Construct Positive Reciprocal Matrix

Every evaluation member use fuzzy AHP evaluation scale to express relative weight between each dimensions and criteria, and construct fuzzy Positive Reciprocal Matrix.

Step 4: Consistency Check

The check methods are as follows:

4.1 Consistency Index (C.I.)

According to Consistency Index (C.I.), C.I=0 indicate that evaluation has perfect consistency; C.I>0 indicate that evaluation has consistency; C.I. <0.1 indicate that evaluation has evaluation has tolerant bias.

4.2 Consistency Rate (C.R.)

Saaty (1980) [5] supposed that Consistency Rate (C.R.) to evaluate the con-sistency of pairwise comparisons in a matrix among criterions. Under the condition of different rank of matrix, it produce different random index (R.I.). Under the condition of the same rank of matrix, the ratio of C.I. to R.I. is called C.R.. When C.R≤0.1, the consistency level is acceptable.

Step5: Calculate fuzzy weight value

Utilize the Lambda-Max method which Csutora and Buckley (2001) [17] pro-posed, calculate the fuzzy weight of evaluation criterions. The steps of calculation are as follows:

5.1 When α=1, use α-cut to get median Positive Reciprocal Matrix. Then, calculate the weight use AHP method to get the weight matrix.

5.2 When α=0, use α-cut to get minimum positive reciprocal matrix and maximum positive reciprocal matrix. Then, calculate the weight use AHP meth-od to obtain the weight matrix.

5.3 In order to make sure that calculated weight value is fuzzy number, there-fore, adjusted the coefficient.

5.4 After obtained adjusted coefficient, calculate minimum positive reciprocal weight matrix and maximum positive reciprocal weight matrix of every measurement dimension.

5.5 Combing adjusted minimum, maximum and median values to get the fuzzy weight in kth evaluation member and kth measurement dimension.

5.6 Utilize average method to integrate the fuzzy weight of evaluation members and measurement dimensions.

RESULTS

1. Survey Candidates

Based on previous studies on applying the BSC approach to information systems, this study used the 21 indicators as performance evaluation indicators to construct the research model and develop the questionnaire items based the model. The 20 indica-tors are showed in Table 1.

Next, take the central engineering government department as the example, and cal-culate the weights of all dimensions and indicators of the model using the AHP and Fuzzy AHP methods. The questionnaire was distributed among Director and Vice Director of the direct department, 7 Director of first-class independent unit, 3 Section Manager of the direct department, and Director of Information Technology, and a total of 13 valid questionnaires were returned and censored 2 invalid questionnaires (refusing answer, incomplete answer, or don't passing the consistency check).

2. Results of the AHP and fuzzy AHP methods

The results of using the AHP and Fuzzy AHP methods demonstrated that the im-portance weights of all dimensions were ordered as follows: internal process, user orientation, business value, and future readiness. Additionally, the results of using the AHP and Fuzzy AHP methods demonstrated that the top three importance weights of performance evaluation indicators were top three indictors are "Control cost," "Satis-fy end user demand," "Operate and maintain information technologies efficiently". However, from rank 4 to 20 performance evaluation indicators, the results of using the AHP method are different with the Fuzzy AHP method. Totally, the results of using the AHP method are slightly different with the Fuzzy AHP method. Theoretically, the Fuzzy AHP method is better than the AHP method. The result of this study is showed in Table 2.

Table 2. The results of using the AHP and Fuzzy AHP methods

Dimension	AHP weight	Fuzzy AHP weight	Indicator	AHP weight	AHP rank	Fuzzy AHP weight	Fuzzy AHP rank
User orientation	0.273	0.277	1. Build and maintain the good image and reputation with end users.	0.045	9	0.046	11
			2. Have the opportunity to develop IT.	0.032	13	0.037	15
			3. Maintain a good relation with user communities.	0.050	8	0.053	8
			4. Satisfy end user requirement	0.110	2	0.098	2
			5. Perceived the preferred IS products and services provider by end users.	0.037	12	0.043	12
Business value	0.239	0.239	1. Manage the good image and reputation.	0.044	10	0.050	10
			2. Make sure IS projects to offer business value.	0.042	11	0.050	9
			3. Control cost.	0.119	1	0.100	1
			4. Be onerous to offer the suitable IS products and services to the third party.	0.030	15	0.040	13
Inner process	0.328	0.328	1. Expect and affect the demands from end users and managers.	0.065	5	0.055	7
			2. Plan and develop IT efficiently.	0.062	7	0.060	5
			3. Operate and maintain IT applications efficiently.	0.070	3	0.064	3
			4. Obtain and test new hardware and software.	0.031	14	0.032	16
			5. Offer to satisfy the end user trainings with effective cost.	0.063	6	0.062	4

			6. Manage the IS problems effectively.	0.066	4	0.055	6
Future readiness	0.156	0.156	1. Expect and prepare the IS problems.	0.024	20	0.029	18
			2. Train and develop regularly to improve IS skills.	0.026	18	0.030	17
			3. Promote regularly IS applications mix.	0.030	16	0.029	19
			4. Increase regularly IS hardware and software.	0.025	19	0.028	20
			5. Implement cost-effective and new technological researches which are suitable for organizations.	0.028	17	0.040	14

CONCLUSIONS

The AHP method is a powerful technique that offers great promise for using the balanced scorecard for practical [6]. However, the decision makers are often uncertain in assigning the evaluation score in using the AHP method. The fuzzy AHP method can conquer this problem. Government organizations and other non-profit organiza-tions use the fuzzy AHP method is liable lead to better balanced scorecard conse-quences.

For Taiwan's information and electronic industries, the framework and methodolo-gy supply, the framework and fuzzy AHP method can serve as a useful modeling instrument in analyzing coupled improvement problems. Identifying the dimensions and performance evaluation indicators offers an important piece of information which would assist managers in Taiwan's government organizations and other non-profit organizations to better understand the main facets of MIS department performance and adopt the right action to enhance the total performance. The framework and fuzzy AHP method not only aid the companies in Taiwan's government organizations and other non-profit MIS organizations to respond to the changes much faster, but also supplies the management teams to move forward with confidence.

This study has some limitations. First, drastically changing environments influ-ences dependency relationships of dimensions and indicators and the accuracy of the proposed model. Second, compared to Miller & Doyle (1987) [18] and Saunder & Jones (1992) [19], the proposed IS evaluation dimensions and indicators more focus non-profit organizations characteristics.

REFERENCES

1. Directorate-General of Personal Administration, Executive Yuan, performance reward and performance management plan (2005)
2. Chu, H.L., Cheng, C.J.: An Empirical Investigation of the Governmental Performance Management System: Using the Balanced Scorecard and the Analytic Hierarchy Process. Journal of Management, 24, 689-705 (2007)
3. Wu, A.: The new direction for performance evaluation. The Chinese BAS Monthly. 530, 43-52 (2000)
4. Kaplan, R.S., Norton, D.P.: The Balanced Scorecard-Measures: That Drive Performance. Harvard Business Review. 70, 72-79 (1992).
5. Saaty, T.L.: The Analytic Hierarchy Process. McGraw-Hill, New York (1980)
6. Yüksel, İ., Dagdeviren, M.: Using the fuzzy analytic network process (ANP) for Balanced Scorecard (BSC): A case study for a manufacturing firm. Expert systems with application. 37, 72-79 (2010)
7. Clinton, D.B., Webber, S.A.: Hassell, J.M.: Implementing the balanced scorecard using the analytic hierarchy process. Management Accounting Quarterly. 3, 1-11 (2002)
8. Searcy, D.L.: Alignment the balanced scorecard a firm's strategy using the analytic hierar-chy process. Mangement Accounting Quarterly. 5, 1-10 (2004)
9. Liedtka, S.L.: Analytic hierarchy process and multi criteria performance management sys-tems. Cost Management, 19, 30-38 (2005)
10. Zadeh, L.A.: Fuzzy Sets. Information and Control. 8, 338-353 (1965)
11. Lee, A.H.I., Chen, W.C., Chang, C.J.: A fuzzy AHP and BSC approach for evaluating per-formance of IT department in the manufacturing industry in Taiwan. Expert systems with application. 34. 96-107 (2010)
12. Kaplan, R.S., Norton, D.P.: The Balanced Scorecard : Translating Strategy into Action. Harvard Business School Press, Boston: MA. (1996)
13. Kaplan, R.S., Norton, D.P.: Strategy Maps: Converting Intangible Assets into Tangible Outcomes. Harvard Business School Press, Boston: MA. (2004)
14. Martinsons, M., Davison, R., Tse, D.: The balanced scorecard: a foundation for the strate-gic management of information systems. Decision Support Systems. 25. 71-88 (1999)
15. Liang, Y.H., Hsieh, H.C., Wang, C.Y.: A Study of Implementing Balanced Scorecard of Government MIS Department-A Case Study of Engineering Department of Govern-ment. Electronic Commerce Studies. 64. 425-445 (2008)
16. Cebeci, U.: Fuzzy AHP-based decision support system for selecting ERP systems in textile industry by using balanced scorecard. Expert Systems with Applications. 36. 8900-8909 (2009)
17. Csutora, R., Buckley, J.J.: Fuzzy Hierarchical Analysis: The Lambda-Max Method. Fuzzy Sets and Systems. 120. 181–195 (2001)
18. Miller, J., Doyle, B.A.: Measuring the Effectiveness of Computer-Based Information Sys-tems in the Financial Service Sector. MIS Quarterly. 11. 107-124 (1987)
19. Saunders, F.A., Jones, J.W.: Measuring Performance of the Information Systems function. Journal of Management Information Systems. 8. 63-82 (1992)

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

ORGANIZATIONAL COMPETENCIES AND THE ENTERPRISE'S EFFECTIVENESS

Dr. Urszula Skurzynska-Sikora, Institute of Management, Faculty of Economics, Maria Curie-Sklodowska University
u.skurzynska@xl.wp.pl

ABSTRACT

Contemporary companies are facing a necessity of their continuous adaptation to new challenges posed by the environment. In order to provide the company with suitable effectiveness, it is necessary to initiate systematically coherent actions related to achieving a permanent competitive advantage. A significant role in acquiring and maintaining such an advantage is played by the company's internal resources based on knowledge, defined as corporate competences.
The paper presents the results of empirical studies performed in order to determine the activities leading to identifying and reducing competence gap in Polish enterprises. The analyses were carried out in 56 companies with the use of a specially designed questionnaire of a categorized interview. While analyzing the obtained results, special attention was paid to the method of interpreting the idea of company's effectiveness, the effect of interpreting effectiveness on company's performance, actions undertaken in order to reduce competence gap and their influence on company's effectiveness.
Finally, recommendations for managers are presented, suggesting the directions for corporate changes leading to better identification and reduction of competence gap, taking into account improved effectiveness of companies' functioning.
The paper was prepared as part of the research project of the National Center for Science - Project No. NN 115419840 "Competencies and the organizational culture of innovative enterprises in an international perspective".

Keywords: organizational competencies, competence gap, reducing competence gap, company's effectiveness
Research paper

INTRODUCTION

The advancement of globalization processes, the growing dynamics and discontinuity of the changes occurring in the environment make contemporary companies face a necessity to accept continuous adaptation to new challenges. A significant role in acquiring and maintaining a permanent competitive advantage by the companies is played by their internal resources based on knowledge, known as organizational competences.

In the economic system based on knowledge the role of such competences is, and most probably will be, increasingly important. Both the competitive position of an enterprise and its effectiveness depend to a high degree on the correct identification of competence gap and on initiating adequate actions aimed at reducing such a gap. The problem is to decide what particular activities should be undertaken and according to what criteria their effectiveness will be evaluated.

CORPORATE COMPETENCES

The term „corporate competences" has been defined in various ways, yet there is agreement that they make a significant factor determining the success of an enterprise. Most generally, competences may be characterized as the capabilities to develop, coordinate and apply the existing resources in order to implement the organization's tasks and reach its objectives (Amit & Schoemaker, 1993).

M. Bratnicki distinguishes the idea of "capabilities" which are attributed to individuals and that of "competences" which refer to the level of the whole organization. According to him, competences are supposed to integrate knowledge (individual capabilities and resources) in order to achieve some goal. Competences understood in this way are in fact capabilities of the individuals who manage the organization and have influence on taking the most vital decisions (Bratnicki, 2000). They are capabilities to acquire adequate resources, including people, and to use them properly to carry out some adopted strategy. However, they are immanently hard to imitate as a potential follower would have to copy the whole complex process of creating and accumulating such resources (Urbanek, 2011).

Competences distinguish a particular organization in its environment and provide it with a competitive advantage. Similarly to other resources determining competitiveness, competences must be valuable from the perspective of the type of business activities, they need to have the properties of rare goods and must be difficult (or/and costly) to imitate. Thus, corporate competences:

- may be understood as a possibility or a capability to acquire some definite effort at a definite level (a capability to perform particular tasks or to carry out particular objectives),
- are always of relative character and must be referred to a standard, an assumed objective or task (competences to do what? And/or in what area?),
- are manifested by one's ability to behave adequately to the requirements of a particular situation (Sitko-Lutek, 2007).

A significant role from the perspective of an enterprise is played by the so-called key competences which help companies to compete effectively on the market due to fulfilling in a better way their customers' needs. Key competences vary from ordinary ones because the former have to:

- possess a potential to be applied on different markets,
- have a significant share in creating values for the customer,
- be difficult to imitate by competitors (Hamel & Prahalad, 1990).

An analysis of key competences may be performed with the use of a model of „core competences" which considers the relationships between the resources, capabilities, competences and key competences (Gierszewska, 2005).

At the lowest level there are tangible and intangible resources as the elements which make a contribution to the chain of values, though they are of a relatively low value to the company. Among intangible assets eight basic categories have been distinguished, and these are related to technology, developing a relationship with the client, the method of drawing up contracts, data processing (e.g. specialist software), human resources, marketing, company's location and goodwill. The degree of taking advantage of the assets possessed by the company which

at the same time determines the potential of a particular organization is called capabilities. On the other hand, competences are a set of capabilities along with the know-how and result from organizing and coordinating individual links of the value chain.

COMPETENCE GAP

To a contemporary manager, competence gap plays an increasing role and it becomes necessary to identify and to reduce it. This results primarily from the fact that in the contemporary global economy competences become an asset which is decisive for the success. Competence gap may be understood as:

- „a lack or a deficiency of abilities" necessary to reach the goals and tasks of the organization or to achieve the results which the managerial staff regard to be „attainable" with the existing material and personnel resources; or achieving the results obtained by the leader or a group of the best companies in a given industry.
- the difference between the desirable (in managers' opinion) competences and the actual ones, and between the structure and the level of competences owned by the managerial staff and the desirable or required competences (Sitko-Lutek, 2007; Urbanek, 2011).

Competence gap is of a dynamic character and it seems necessary to adopt a perspective of an analysis which will take into account not only an approach in the context of widely understood organizational "resources" (or the organization's potential), but also their active utilization in order to understand this phenomenon comprehensively. Since competence gap refers to the unique competences of the organization which determine its chance to gain the competitive advantage over the other organizations and the possibilities of their practical application.

It should be stressed, however, that analyzing competence gaps occurring in the particular competence areas of an enterprise does not fully take into consideration the aspect of complexity and structurization of organizational competences. Ensuring the effectiveness of a number of organizational processes requires that the company should have at its disposal competences which make it possible to coordinate the actions implemented in different competence areas, which means that studying gaps in individual areas is usually insufficient for a full recognition of the competence gap existing in the company.

Thus it is necessary to adequately identify and analyze the signals coming from the environment, taking into account their influence on the current and future situation of the company as a whole, and also predicting on the basis of such signals the directions of the changes in the environment and core competences which condition the company's functioning in the future. However, in the practice of Polish enterprises, it turns out that although the knowledge acquired in this way is indispensable to prepare the necessary strategy and a consistent construction of a set of adequate competences, then, unfortunately, in case of many firms it does not provide a basis to design the directions for their future activities. The results of empirical studies carried out by different teams suggest that the development of many companies is a consequence of an accident, a sudden opportunity, such as a possibility to buy some exceptionally cheap tangible assets, an unexpected offer of co-operation from a big company, using aid funds from the European Union, finding a new investor, a company merger, favorable systemic solutions,

etc. (Krupski, 2007). Such an opportunity provides an impulse to act, yet it depends on the company's competences whether and to what extent the company will take advantage of it.
The identified competence gap may be reduced in many ways which include for example: acquiring tangible assets or financial resources, finding specialists on the job market, co-operation with consulting companies, training (internal and external), outsourcing (Sitko-Lutek & Skrzypek, 2009).

ENTERPRISE'S EFFECTIVENESS

Effectiveness is one of the basic categories used to assess the company's performance, however, there are significant discrepancies concerning its defining in practice. Still quite recently, the effectiveness of an enterprise was identified with its productivity understood as production volume, turnover or sales volume. However, it was observed that the effectiveness of work is affected by qualitative factors, such as e.g. the employees' qualifications, their education or experience. The effectiveness understood in this way should be assessed by means of other measures, e.g. the effects of work (quantity/quality of work) or work expenditure (costs of work, time, laboriousness or the number of the employees) (Kożusznik, 2002).

The diversity of approaches concerning the definition of effectiveness results in a number of approaches concerning its measurement. Generally, it should be stressed that the key role is played by a precise identification of the aims and expectations. The measures used here are of double character:

- predictive – they concern planning some expected results and identifying any interferences which make the results obtained different than those intended (both above and below expectations); such measures play the role of a system of early warning;
- corrective – related to creating standards of improved activities in future projects (Buchanan, 2008).

In order to make the measures genuinely significant, they have to be adapted to the organization's objectives, such as its effectiveness or productivity, and referred to suitable implementers who have real influence on the degree of the objectives' realization. In practice, effectiveness depends on many factors, which makes its assessment much more complicated.

In recent years a growing popularity among the concepts of multi-aspect assessment of the company's effectiveness has been enjoyed by the Balanced Scorecard (BSC) developed by R.S. Kaplan and D.P. Norton, in which they observed a need to adopt a holistic view on the company in the process of formulating its strategic objectives and assessing effectiveness understood as the degree of implementing the company's strategy and analyzed in four areas – apart from the financial aspects, it is necessary to take into account the market perspective (the client), internal processes and innovations and learning (Kaplan & Norton, 2005).

An interesting approach to assessing the effectiveness of an organization was put forward by G.A. Rummler and A.P. Brache (2000). Bearing in mind the fact that an organization is a system and that there are different processes implemented inside it, occurring among the individual spheres of the organization, they paid special attention to the necessity to correlate

the activities within the whole organization and to eliminate problems referring to inter-functional relationships. In their concept the effectiveness of an organization is analyzed in a two-level system – the dimension of the organization and the need for effectiveness. The level of the organization includes :

- the level of the whole organization,
- the level of the process;
- the level of the position (Rummler & Brache, 2000).

The second dimension, the need for effectiveness, is influenced by the results obtained on each level of the organization, which include :

- objectives;
- designing methods;
- management methods **(**Rummler & Brache, 2000).

As a result, nine variables are distinguished which influence the effectiveness of an organization. Thus it may be claimed that skillful effectiveness management requires a suitable formulation of the objectives, designing and managing each of the three levels: the organization, process and work place, with all the three levels being interrelated, e.g. a job cannot be adequately described without understanding the processes in which it is involved. Any attempt to define the organization's objectives without relating them to the processes and the system of employee effectiveness must end in a failure.

ORGANIZATIONAL COMPETENCIES AND THE ENTERPRISE'S EFFECTIVENESS IN THE LIGHT OF RESEARCH

1. Research methods

The empirical studies aimed, among others, at determining a set of key resources and capabilities necessary to develop and maintain a permanent competitive advantage, the methods of identifying competence gap and to take up activities towards its elimination as a result of corporate learning, to recognize differences in learning processes and also to determine factors which support or hinder the identification of changes in competence gap.

The research was done in 56 Polish companies of different size. The structure of the research sample is as follows:

- 14.3 % of the companies were small firms (employing less than 50 people),
- 51.8 % - medium-size companies (employing from 50 to 249 people),
- 33.9 % - large enterprises (employing more than 250 people);

The competences of the companies were analyzed in 9 functional areas: operating activities (manufacturing, services, trade), technology, research and development, marketing/sales, finance, human resources, supplies, quality and management (including: strategic planning, operational planning, corporate structure, corporate culture).

2. Results

Definitely, the most popular way of perceiving effectiveness in companies is identifying it with gaining a competitive advantage, increasing number of clients and increasing competitive advantage (see Table 1). None of the respondents representing small businesses believes that gaining a competitive advantage proves the company's effectiveness. In the

situation of the competitive global market gaining a competitive advantage by a small company is extremely difficult. This may be why the managerial staff, being rationalistic, do not assume that this type of organizations may gain a competitive advantage as this is a rather impossible option.

Big enterprises adopt a long-term orientation. What matters to them is implementing the plan (intended objectives). They are less oriented towards obtaining a positive financial result in a short time. As a consequence, the managerial staff in big companies see effectiveness as related to the organization's stable functioning and development.

Table 1. Understanding effectiveness in the studied companies

Specification	Total	Companies		
		Big	Medium	Small
1. Degree to which the intended objectives are met	66,1	73,68	62,07	62,50
2. Efficiency of company's functioning	50,0	52,63	48,28	50,00
3. Promptness to react to challenges and market expectations	48,2	42,11	51,72	50,00
4. Positive financial result	57,1	47,37	62,07	62,50
5. Systematic improvement of the financial performance	48,2	52,63	37,93	75,00
6. Increase in market share	57,1	52,63	58,62	62,50
7. Promptness to adapt to clients' expectations	50,0	47,37	48,28	62,50
8. Increase in clients' satisfaction	46,4	42,11	41,38	75,00
9. Increase in sales income	37,5	31,58	37,93	50,00
10. Implementing the enterprise's strategy	42,9	42,11	41,38	50,00
11. Growing number of clients	21,4	21,05	20,69	25,00
12. Improved image of the company	37,5	31,58	41,38	37,50
13. Gaining competitive advantage	28,6	36,84	31,03	0,00
14. Maintaining competitive advantage	25,0	26,32	24,14	25,00
15. Balanced functioning in the environment	14,3	10,53	17,24	12,50
16. A tool of improving the company's competitiveness	19,6	15,79	20,69	25,00

Source: own work

The companies carried out self-assessment regarding their competences, using a five-level scale (l- very low, 2- low, 3- average, 4- high, 5 – very high). The obtained results are presented in Table 2.

Table 2. The assessment of companies' potential in individual competence areas

No.	Competence area	Total	Enterprises		
			Small	Medium	Large
1.	Operating activities (manufacturing, services, trade)	3,98	4,13	3,83	4,16
2.	Technology	3,96	4,25	3,79	4,11
3.	Research and development	3,00	3,50	2,82	3,05
4.	Marketing/sales	3,79	4,13	3,55	4,00
5.	Finance	3,8	3,75	3,66	4,05
6.	Quality	4,14	4,38	4,03	4,21
7.	Human resources	3,98	4,38	3,83	4,05
8.	Supplies	3,93	4,14	3,86	3,95
9.	Management - average	3,98	4,25	3,83	4,11
10.	Management - strategic planning	3,98	4,25	3,83	4,11
11.	Management - operational planning	4,13	4,38	3,90	4,37
12.	Management - corporate structure	3,87	4,00	3,76	4,00
13.	Management - corporate culture	3,82	4,00	3,69	3,95
	Average	**3,86**	**4,11**	**3,70**	**4,00**

Source: own work

Respondents assessed the potential competence of its enterprises as almost high (average 3.86). Maximum of their potential has been assessed in small businesses (average 4.11) and only in the areas of operations and finance indicated the highest level of competence in large enterprises. It should be noted that in all areas of competence of medium-sized companies assessed the lowest. Top assessed capacity of competence in the field of quality (average 4.14) and operating activities (manufacturing, services, trade) (4.13), the least in the area of research and development (3.00).

In order to improve the effectiveness in the analyzed companies, different actions were initiated. The present study made use of sets of actions which are regarded as adequate while reducing competence gap. The activities undertaken in the companies and their effect on improving companies' potential (improved resources and capabilities) in particular functional areas in different categories of enterprises are presented in Table 3.

Table 3. The activities undertaken in the companies and their effect on improving companies' potential (improved resources and capabilities) in particular functional areas in different categories of enterprises

Functional areas / Undertaken activities		Operating activities	Techniques and technologies	Research-and-development activities	Marketing/sales	Finance	Quality	Human resources management	Supplies	Management
1.	Acquiring material resources	3,63	3,91	2,25	3,12	3,15	3,73	3,12	3,25	3,43
2.	Acquiring financial resources	3,81	3,87	2,65	3,35	3,62	3,44	2,95	2,97	3,21
3.	Introducing elements of knowledge management	3,31	3,58	2,55	3,26	3,28	3,44	3,58	2,94	3,76
4.	Recruiting specialists on the job market	3,47	3,27	2,51	3,29	3,17	3,13	3,46	2,72	3,26
5.	Acquiring competences from a business partner	2,97	3,03	2,29	2,82	2,38	2,74	2,55	2,52	2,81
6.	Cooperation with consulting companies	2,5	2,51	2,24	2,82	3,00	2,68	2,74	2,06	2,92
7.	Cooperation with research institutions	1,83	2,64	2,75	2,12	1,84	2,41	1,9	1,61	2,23
8.	Training courses	3,33	3,22	2,44	3,33	3,26	3,57	3,7	2,7	3,6
9.	Developing research-and-development potential	2,34	2,65	2,83	2,24	1,87	2,33	2,24	1,77	2,03
10.	Learning in action	3,94	3,7	3,03	3,89	3,58	3,89	3,67	3,39	3,71
11.	Outsourcing	2,75	2,17	1,79	2,00	2,13	2,10	2,36	2,00	2,10
12.	Learning from competitors	3,12	3,10	2,26	3,48	2,21	2,82	2,37	2,50	3,11

Source: own work

According to the respondents the greatest influence on the growth potential of enterprises competence was learning in action (on average in all areas of 3.64) and acquiring financial resources (3.32). The relatively least important in the growth potential of competence had cooperation with research institutions (3,15).

In the various functional areas are taken actions aimed at increasing competence potential and their efficiency evaluated in a range from an average of 3.14 in the area of techniques and technologies to 2.45 in area of research-and-development activities.

Among the methods applied to improve the competence potential and reduce competence gap the analyzed companies (see Table 4), the largest influence on improved effectiveness resulted, according to the respondents, from training (42.5%), learning in action (40%) and acquiring additional tangible assets (31.9%). The lowest advantage resulted from the companies' co-operation with research-and-development institutions (11.6%), outsourcing (13.6%) and building their own research-and-development potential (17.5%).

The meaning of the particular methods for improved effectiveness is assessed differently depending on the size of a company. Training was most important in big and small companies, while medium-size companies regarded learning in action as more vital. Big and small businesses decided that introducing elements of knowledge management was second most important issue. Small companies emphasized the role of acquiring financial assets as significantly affecting improved effectiveness of their functioning.

Table 4. Popularity of using the methods of reducing competence gap to improve company's effectiveness

Method used to reduce competence gap	Enterprises			
	Total	Big	Medium	Small
Acquiring material resources	32,85	29,47	32,07	43,75
Acquiring financial resources	31,42	24,74	29,66	53,75
Introducing elements of knowledge management	33,40	36,32	25,86	53,75
Recruiting specialists on the job market	29,64	25,79	26,55	50,00
Acquiring competences from a business partner	18,75	16,84	16,55	31,25
Cooperation with consulting companies	20,00	20,53	16,21	32,50
Cooperation with research institutions	11,61	13,68	9,31	15,00
Training courses	42,69	40,53	38,96	60,00
Developing research-and-development potential	17,48	11,58	20,34	21,25
Learning in action	39,99	34,21	42,42	45,00
Outsourcing	13,57	12,11	10,35	28,75
Learning from competitors	24,43	19,47	21,72	46,25

Source: own work

3. Conclusions

To handle dynamically developing requirements of the environment, an organization has to ensure some adequate competence potential. Thus it is necessary to monitor systematically the requirements put forward by the environment and to identify competence gap which is created. The awareness of competence gap releases the processes of its reduction. While selecting suitable actions aimed at reducing the gap, it is necessary to pay attention to the

effectiveness of undertaken activities. The knowledge and skills of the managerial staff in the company may be often insufficient to face new challenges independently. In such situations it is recommended that professional consultants should be asked for help.

The studies revealed that according to the respondents the effectiveness of their companies was influenced primarily by training, much recognition was also given to learning in action. Thus it can be concluded that the role of corporate learning is appreciated.

It seems indispensable to introduce mechanisms which would lead to permanent corporate learning and at the same time guarantee the expected level of effectiveness. In order to achieve this, the following recommendations are suggested:

- Paying special attention to identifying objectives and determining precise measures, as well as correlating them adequately in the company,
- Analyzing the obtained results in due course; when a gap is observed between the results and the intended objectives it is necessary to identify its reason and to initiate suitable corrective actions;
- Regular collaboration with consultants while providing a service, learning from them and also introducing the mechanisms of knowledge transfer in the company;
- Creating a bank of information which should be used while taking decisions and constant improvement of the organization's effectiveness.

REFERENCES

1. Amit, R. & Schoemaker, P. J., 1993. Strategic Assets and Organizational Rent. *Strategic Management Journal,* Issue 1 (14), pp. 33-46.
2. Bratnicki, M., 2000. *Kompetencje przedsiębiorstwa. Od określenia kompetencji do zbudowania strategii.* Warszawa: Placet.
3. Buchanan, J., 2008. Measuring up. *PM Network*, 22 (9), pp. 50-55.
4. Gierszewska, G., 2005. Kompetencje strategiczne na poziomie organizacji. in: E. Masłyk-Musiał (ed.), *Zarządzanie kompetencjami organizacji.* Warszawa: Wyższa Szkoła Menedżerska.
5. Hamel, G. & Prahalad, C. K., 1990. The Core Competence of the Corporation. *Harvard Business Review*, May-June, pp. 79-90.
6. Kaplan, R. S. & Norton, D. P., 2005. The Balanced Scorecard: Measures That Drive Performance. *Harvard Business Review*, 83 (7/8), pp. 172-180.
7. Kożusznik, B., 2002. *Psychologia zespołu pracowniczego. Doskonalenie efektywności.* Katowice: Akademia Ekonomiczna.
8. Krupski, R., 2007. Redefiniowanie strategii organizacji. *Przegląd Organizacji*, No 3, pp. 8-12.
9. Rummler, G. A. & Brache, A. P., 2000. *Podnoszenie efektywności organizacji.* Warszawa: Polskie Wydawnictwo Ekonomiczne.
10. Sitko-Lutek, A. (ed.), 2007. *Polskie firmy wobec globalizacji. Luka kompetencyjna.* Warszawa: Wydawnictwo Naukowe PWN.
11. Sitko-Lutek, A. & Skrzypek, E. (ed.), 2009. *Organizacyjne uczenie się w rozwoju kompetencji przedsiębiorstw.* Warszawa: C.H.Beck.
12. Urbanek, G., 2011. *Kompetencje a wartość przedsiębiorstwa. Zasoby niematerialne w nowej gospodarce.* Warszawa: Wolters Kluwer.

Dr. Urszula Skurzynska-Sikora,
Institute of Management, Faculty of Economics, Maria Curie-Sklodowska University
u.skurzynska@xl.wp.pl
20-031 Lublin, Pl. M.Curie-Sklodowskiej 5, Poland
Assistant Professor at the Institute of Management in the Faculty of Economics, at the Maria Curie-Sklodowska University in Lublin (Poland). A specialist in the field of management sciences. For many years, leading scientific, teaching and training activities in issues of the management. Current scientific interests are focused on issues of strategic management, organizational competencies and their influence on the efficiency of the enterprises. Author and co-author of several dozen scientific publications.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

USING CLUE AS A SOFTWARE PLATFORM TO TEACH ARTIFICIAL INTELLIGENCE: CONTINUING INVESTIGATION AND DEVELOPMENT

Adrian A Angeles, University of the Philippines, Philippines
Email: adrian.angeles@up.edu.ph

Bernardo Z Cinco, University of the Philippines, Philippines
Email: bernardo.cinco@up.edu.ph

Paul Vincent S Contreras, University of the Philippines, Philippines
Email: paul_vincent.contreras@up.edu.ph

ABSTRACT

ClueMe is a programming platform which aims to provide a new way for high school students to learn basic concepts of artificial intelligence. Its goal is to be able to provide an easy-to-use drag-and-drop interface where the user can customize programmable agents. The platform is similar to programming utilities such as Scratch and ToonTalk set in the murder-mystery deduction board game Clue (Cluedo in some markets). Users treat the characters in the game as software agents whose actions and decisions are programmed. The user may then pit his programmed agent (hereby referred to as "player") against other players or against a stock player provided.

ClueMe was divided into two components: the main game (Clue/Cluedo) and the programming interface.

The developers utilized source code written for a Clue game and modified it to allow the option of choosing players that are user-designed. The ClueMe programming interface, patterned after Scratch, utilizes tiles that restrict the allowed actions for the user based on syntactical synergy.

The project hopes to look at the efficacy of using soft programmable agents to aid in the education of Computer Science concepts at the secondary level and early tertiary level of education. The researchers hypothesize that gamifying the learning of programming agents by making players compete against other designs will motivate students to study the underlying principles of the tasks that their agents must perform to outplay others.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

A STUDY ON RELATIONSHIP AMONG ORGANIZATIONAL TRUST, ORGANIZATIONAL JUSTICE AND ORGANIZATIONAL SPIRITUALITY

Yen-Ku Kuo, Chinese Culture University
Email: ykkuo@sce.pccu.edu.tw

Tsung-Hsien Kuo, Chinese Culture University
Email: love8671@gmail.com

Chien-Ting Lin, Chinese Culture University
Email: ctlin@sce.pccu.edu.tw

Yung-Heng Lee, Chinese Culture University
Email: yuhlee@sce.pccu.edu.tw

Bang-Lee Chang, Chinese Culture University
Email: blchang@sce.pccu.edu.tw

Ying-Yueh(Janice) Su, Chinese Culture University
Email: yysu@sce.pccu.edu.tw

Li-An Ho, Tamkang University
Email: lianho@mail.tku.edu.tw

ABSTRACT

Enterprises must be from angle of human resources management to create the difference in the present fierce business environment of competition. The member is enterprise's most important assets; the more important thing is an administrator should grasp the staff's psychology.

This research explores the relation of organizational trust, organizational justice and organizational spirituality, further compare someone is more powerful to organizational spirituality. Use questionnaire investigation, it is supposed and then study with the statistics technology of structural equation modeling, there is apparent prediction strength forward on organizational spirituality to find organizational trust and organizational justice.

The management meaning of the conclusion offers the industry to make as strategy, offer better manpower resources management, create and organize it with staff's win-win wishing the scene.

Keywords: organizational trust, organizational justice, organizational spirituality

INTRODUCTION

Modern all enterprises need to satisfy customers to survive in the society. However, at the highly competitive pressure, good service quality and products are no longer the best method, so the route that enterprises want to have advantage of competitiveness to look for innovation.

The human resources are the most important assets in organization, only people can't lack the advantage that can't replace in enterprises either. The thinking of internal marketing has become the business administration important tactics recently. The executives of enterprises know that there are satisfactory staff that can increase the satisfactory customer. The staff's idea and attitude are questions that the administrator needs to understand.

A lot of scholars carry on research to satisfaction, commitment and identification, the purpose is to understand whether member's positive view on enterprises has influenced performance and efficiency. Organizational trust received the psychologist's attention in the 1990s, Define it is the staff that, to the colleague, executive and trust of the organization, if the higher the intensity of trust is, can infer that there is contribution to organizing even more. In addition, organizational justice theory is paid attention to the literature in most recent ten years, can be from distributive, procedural, and interactional justice comes to assess, the member feel correct or not to all activities then pay more suspicious strength to enterprises.

Organizational spirituality is a new topic, originated from the religious group, explained the staff's inner life, meaningful work and community, would like to devote it to enterprises with diligent spirit.

There was not discussed organizational trust at the same time at present, research of organizational justice and organizational spirituality, so an article will take this as the focal point to discuss their relevance.

LITERATURE REVIEW

1. Organizational trust

When conceptualized as a psychological state, trust has been defined in terms of several interrelated cognitive processes and orientations (Blau,1964). It characterized trust as a set of socially learned and socially confirmed expectations that people have of each other, of the organizations and institutions in which they live, and of the natural and moral social orders that set the fundamental understandings for their lives. Several organizational researchers have argued the usefulness of conceptualizing trust in terms of individual choice behavior in various kinds of trust dilemma situations (Meyer, 1994). From the social-capital perspective, the accumulation of social capital requires a significant amount of trust to be established in and between all levels of an organization (Sashittal, 1998).

2. Organizational justice

Organizational justice is a concept that was first described by Greenberg (1990) and is defined as an individual’s perception of, and reaction to, fairness in an organization.

According to Adam's (1965) equity theory, it is proposed that conditions of unfairness will create tension within a person, which he or she will attempt to resolve. The concept of justice is one of the important variables in organizational behavior, Organizational justice is defined as the processes and procedures being measured, regular and that the staffs find their leaders impartial, sincere and that they find the deeds logical (Niehoff et al, 1993).

3. Organizational spirituality

Interest in spirituality and religion has grown considerably in scientific and professional communities over the past three decades. While the bulk of that interest has found expression in research focusing on the relation of religion and spirituality to general health and well-being (Ashmos & Duchon, 2000).

Inner life is the strength that individual produces from inside, surmount in personal life, through the values perceived oneself. Meaningful work is that the staff find the meaning of the work and contribution to the society and affirm value and meaning of the life from working experience. Community is linking each other between the job groups, cooperate together and encourage the mutual consciousness.

4. Organizational trust, organizational justice and organizational spirituality

Through the literature discussion can get the better organizational trust and organizational justice are will improve as to organizational spirituality. Many research found the staff's organizational trust can make the whole enterprise have better performances after improving(Liu et al, 2012; Mitchell et al, 2012; Nambudiri, 2012; Wong et al, 2012).
This research address two hypothesizes:
H1: Organizational trust has forward significant influence on organizational spirituality.
H2: Organizational justice has forward significant influence on organizational spirituality.

RESEARCH DESIGN

1. Research structure

The structure chart of this research is drawn and shown as follows.

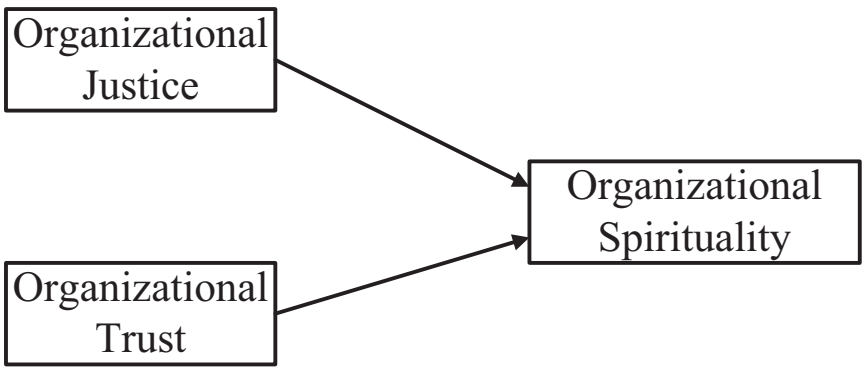


Figure 1 Research structure chart

2. Participant

Small and medium-sized enterprises are research objects in Taiwan, the questionnaire investigation used, send 500 questionnaires and retrieve 210 successful samples; the rate of recovery is 42%.

3. Research tool

There are two dimensions in organizational trust, Cognitive and affective trust. Organizational justice has three parts: distributive, procedural, and interactional justice. In addition it is inner life, meaningful work and community in organizational spirituality.

In order to examine each assumption, use AMOS 20.0 as and count tools and calculate reliability and validity.

FINDING AND DISCUSSION

1. Confirmatory factor analysis

Three main constructs are organizational trust, organizational justice and organizational spirituality. Through the analysis of CFA, composite reliability is 0.8673 of organizational trust, average variance extracted is 0.7657; Composite reliability is 0.8294 of organizational justice, average variance extracted is 0.6214; Composite reliability is 0.9154 of organizational spirituality, average variance extracted is 0.7836. Show convergent validity of three constructs are very good, compare the square root of average variance extracted and all correlations represents discriminant validity. Refer to Table 1 and Fig. 2.

Table.1 AVE & correlation

	Orgazizational Justice	Organizational Trust	Organizational Spirituality
Orgazizational Justice	0.7882		
Organizational Trust	0.6081	0.8750	
Organizational Spirituality	0.6511	0.5693	0.8852

Note: The diagonal number value is the square root of AVE

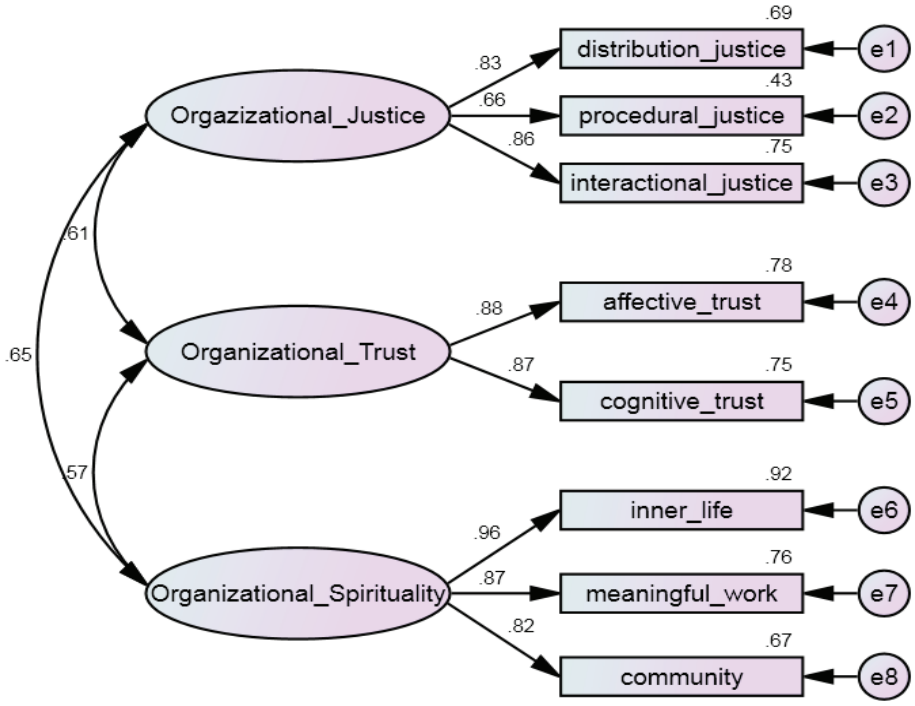


Figure 2 Confirmatory factor analysis

2. Structure model and hypothesis examined

Further hypothesis examined after Confirmatory factor analysis, finds structure model fit is good. Chi-square is 20.692, GFI is 0.978, AGFI is 0.952, CFI is 0.978, NNFI is 0.994, IFI is 0.997 and RMSEA is 0.032, all indicators reach the standard number value. In addition, use bootstrap to estimate standardized regression coefficients reaches statistically significant too, show all hypothesis gets support. Refer to Table 2 and Fig. 3.

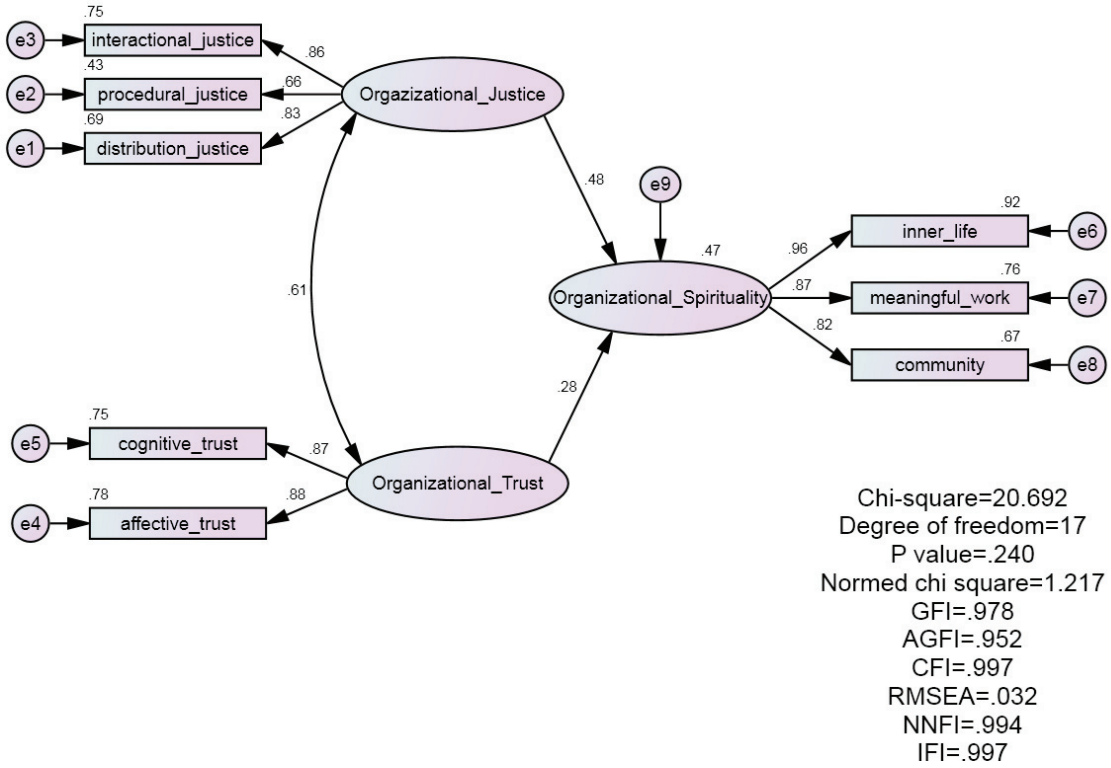


Figure 3 Structural model

Table.2 standardized regression coefficient & significance

Parameter			Estimate	Lower	Upper	P
Organizational Spirituality	**<---**	**Orgazizational Justice**	**.4839*** **	**.2889**	**.6849**	**.0007**
Organizational Spirituality	**<---**	**Organizational Trust**	**.2750***	**.0619**	**.4743**	**.0120**
distribution justice	<---	Orgazizational Justice	.8335	.7330	.9001	.0018
procedural justice	<---	Orgazizational Justice	.6585	.5573	.7392	.0008
interactional justice	<---	Orgazizational Justice	.8635	.7883	.9188	.0024
affective trust	<---	Organizational Trust	.8830	.7840	.9622	.0014
cognitive trust	<---	Organizational Trust	.8672	.7931	.9363	.0011
inner life	<---	Spirituality	.9617	.9236	.9911	.0017
meaningful work	<---	Spirituality	.8723	.8064	.9226	.0014
community	<---	Spirituality	.8206	.7284	.9004	.0010

* $p < 0.05$, ** $p < 0.01$, ***$p < 0.001$

CONCLUSION

Originally finding organizational trust, organizational justice has forward significant influence on organizational Spirituality, hypothesis gets support. The function of organizational justice is more important, so enterprises should pay attention to organizational justice more, make the staff think in enterprises that there is fair treating. In order to improve the competitiveness, enterprises should combine the strategy, human resource management and concern staff, strengthen organizational trust and organizational justice make organizational spirituality better. Propose looking for mediator or moderator to make research framework more intact in the middle of main relationship in the future.

REFERENCES

1. Adams, J. S. (1965). Inequity in social exchange. In L. Berkowitz (Ed.), Advances in Experimental Social Psychology, 2, 267-299. New York: Academic Press.
2. Ashmos, D., & Duchon, D. P. (2000). Spirituality at work: A conceptualization and measure. Journal of Management Inquiry, 9(2), 134-145.
3. Blau, P. M. (1964). Exchange and power in social life. New York: Wiley.
4. Greenberg, J. (1990). Organization justice: yesterday, today, and tomorrow. Journal of Management, 6, 399-432.
5. Liu, N. T., & Ding, C. G. (2012). General ethical judgments, perceived organizational support, interactional justice, and workplace deviance. International Journal of Human Resource Management, 23(13), 2712-2735.
6. Meyer, R. (1994). Universal Optimality of Rank Constrained Matrix Approximation. In Information Systems and Data Analysis: Prospects - Foundations - Applications (H.H. Bock, W. Lenski, M.M. Richter, Eds.), Studies in Classification, Data Analysis, and Knowledge Organization, 4, Springer, Berlin, 335-342.
7. Mitchell, J. I., Gagne, M., Beaudry, A., & Dyer, L. (2012). The role of perceived organizational support, distributive justice and motivation in reactions to new information technology. Computers in Human Behavior, 28(2), 729-738.
8. Nambudiri, R. (2012). Propensity to trust and organizational commitment: a study in the Indian pharmaceutical sector. International Journal of Human Resource Management, 23(5), 977-986.
9. Robbins, S. P. (2001). Organizational behavior (9th ed.). Eaglewood Cliffs, NJ: Prentice Hall Press.
10. Rupp, D. E., Cropanzano, & Russell (2002). The mediating effects of social exchange relationships in predicting workplace outcomes from multifoci or organizational justice. Organizational Behavior and Human Decision Processes, 89(1), 925-946.
11. Sashittal, H. C., Berman, J., & Selim, I. (1998). Impact of trust on performance evaluations. The Mid - Atlantic Journal of Business, 34(2), 163-184.
12. Wong, Y. T., Wong, C. S., & Ngo, H. Y. (2012). The effects of trust in organisation and perceived organisational support on organisational citizenship behaviour: a test of three competing models. International Journal of Human Resource Management, 23(2), 278-293.
13. Yochi & Spector, P.E. (2001). The role of justice in organizational a meta-analysis. Organizational Behavior and Human Decision Process, 86(2), 278-321.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

RELATIONSHIP BETWEEN KNOWLEDGE MANAGEMENT PRACTICES AND LIBRARY USERS' SATISFACTION: A PRELIMINARY RESULT OF MALAYSIAN UNIVERSITY LIBRARIES

Che Rusuli M.S., Department of Production and Operation, Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia, Batu Pahat 86400, Malaysia.

Tasmin R., Department of Production and Operation, Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia, Batu Pahat 86400, Malaysia.

Takala J., Department of Production, Faculty of Technology, University of Vaasa, City of Vaasa, Finland

Norazlin H., Department of Information Technology, Center For Diploma Studies Universiti Tun Hussein Onn Malaysia, Batu Pahat 86400, Malaysia.

K Phusavat, Department of Industrial Engineering, Kasetsart University Kasetsart University, Bangkok 10900, Thailand.

Walsh J., School of Management, Shinawatra International University, BBD Building (Viphawadi), Viphawadi-Rangsit Road, Phaya Thai, Bangkok 10400, Thailand

Raja Abdullah Yaacob, Faculty of Information Management, UniversitiTeknologi MARA, Puncak Perdana Campus, No. 1, Jalan Pulau Angsa AU10/A, Section U10, 40150.Shah Alam, Selangor. Malaysia.
email: msaufi@uthm.edu.my

ABSTRACT

It is known that "Knowledge Management" is associated with significant benefits which can empower organizations in the whole world especially University libraries to get more competitive in their environment. Knowledge Management Practice (KMP) and Library Users' Satisfaction (LUS) are two vital aspects of Knowledge Management (KM) which play an important role in creating organizational value. Most organizations, such as University Libraries focus on enhancing their capability of knowledge processes to create new knowledge. The aim of this paper is to test empirically levels and types of KM practice applied at Malaysian university libraries. Based on 35 questionnaires through online, a survey was administered to a Lead User group in libraries (PhD candidates) in Malaysia. This is to elicit opinion of the prime users on the linkage between Knowledge Management Practice (KMP) and Library Users' Satisfaction (LUS). SPSS software were utilized to analyze research data using reliability analysis and Pearson correlation. Results obtained show that Knowledge Management Practice (KMP) has positive influence on the Library Users' Satisfaction (LUS). However, a meaningful

linkage was observed between Library Users' Satisfaction (LUS) with two vital constructs of Knowledge Record (KRe) and Knowledge Preserving (KPr). The main contribution of the paper is to provide groundwork empirical evidence about the linkage between Knowledge Management Practice (KMP) and Library Users' Satisfaction (LUS) at Malaysian university libraries. Moreover, it reveals what is the most effective KM Practice, specifically knowledge process. For this relationship purpose, it provides organizations with some preliminary implications in order to shape their knowledge management practices. It is evinced that there is a positive and strong relationship between Knowledge Management Practice (KMP) and Library Users' Satisfaction (LUS).

Keywords: Knowledge Management Practice; Malaysia, Knowledge Record; Knowledge Preserving; University libraries; Library Users Satisfaction.

INTRODUCTION

The KM changes are evolutionary. Today, libraries are adding new processes and activities, digital resources and services while maintaining most of the old, traditional resources and services. We realize that in 21st century, libraries have gone through an evolutionary. However, libraries are still practicing the conventional process, which is to collect, process, disseminate, store and utilize information to provide service to the university community (Daneshgar & Bosanquet, 2010; Feng, Jeusfeld, & Hoppenbrouwers, 2001; Foo, Chaudhry, Majid, & Logan, 2002; Roknuzzaman & Umemoto, 2009). Whatever influences universities activity also affects the environment of academic libraries operate today. The success of Knowledge management in libraries also depends on their ability to utilize information and knowledge of its staff to better serve of the organization needs. Today, we do what we have to do as a librarian in the library to maintain the library function and relevant in time. We realize that there is a need and demand for new evolutionary of technology especially in KM processes in library environment (Feng, *et al.*, 2001). Respondents to a survey conducted by Ernst & Young in 1997 identified the following types of knowledge is about customers, knowledge about best practices and effective processes, knowledge about the company's own competencies and capabilities, knowledge about the company's own products and services, knowledge about the emerging market trends, and knowledge about competitors (C. K. Lee & Al-Hawamdeh, 2002).

In recent decades, knowledge management (KM) has been perceived as another potential viable response to the challenges that the Library and Information Science profession is facing in a continuously changing environment (Sarrafzadeh, Martin, & Hazeri, 2010). There are a number of definitions related to knowledge management practice in libraries. Tandale, *et al.* (2011) defines KM is to create a process of valuing the organization's intangible assets in order to best leverage knowledge internally and externally. Knowledge management, therefore, deals with creating, securing, capturing, coordinating, combining, retrieving, and distributing knowledge. Skyrme and Amidon (1997) defines KM as a "process or practice of creating, acquiring, capturing, sharing, and using knowledge, wherever it resides, to enhance learning and performance in organizations." Brendan (1999) broadly defined KM as a acquisition, sharing and use of knowledge within organizations, including learning processes and management information systems (MIS) or, more specifically, the explicit and systematic management of vital

knowledge associated with processes of creating, gathering, organizing, diffusion, use and exploitation. On a similar note, White (2004) defines KM as "a process of creating, storing, sharing and re-using organizational knowledge (know-how) to enable an organization to achieve its goals and objectives". In a similar view, KM is seen as distinct from both librarianship and Information Management (IM), as it includes knowledge creation and knowledge sharing, and the interplay of tacit and explicit, individual and collective knowledge (Hammer, Leonard, & Davenport, 2004; B. Martin, Hazeri, & Sarrafzadeh, 2006). However, in this study KM defines as "process of creating, acquiring, capturing, sharing, recording and preserving" knowledge. Knowledge management is a dynamic and cyclical process that involves the whole organizational processes, trying to map the existent learning, linking the essential processes and their strategy, in search of better organizational performance, development of the products and services, quality and client's management among others (Conklin, 1996; T. H. Davenport & Prusak, 2002; Wiig, 1997). Zack, *et al.,* (2009) and White (2004) hold similar opinions and view knowledge as a strategic resource. Organizations that succeed in knowledge management are likely to view knowledge as an asset and to develop organizational norms and values, which support the creation and sharing of knowledge (Rowley, 1999). It is strategic and action oriented. In the context of this study academic libraries refer to only university libraries. Wen (2005) states that to prove their relevance and value, academic libraries must strive to provide the right amount of information to the right client at the right time with a right expense of financial and human resources. With a stagnant or dwindling library budget, academic libraries have to increase their operational efficiency in order to meet the challenge. One management tool that can help in this regard is Knowledge Management (KM). Therefore, to implement Knowledge Management Practice in academic libraries is mainly driven by its mission rather than by the competition from Internet-based reference services or electronic books. From the above understanding of definitions, KM is a process of creation, acquisition, capturing, sharing, record and preserving in the library. It is obvious to say that KM does not consist of only tacit knowledge as indicated in some KM literature. It comprises both tacit and explicit knowledge, which are complementary. Jain (2007) stated that KM can be characterized as below:

- KM core process of several activities; creating, acquiring, capturing, sharing, using and re-using it;
- It includes both explicit and tacit knowledge;
- It is an ongoing activity;
- Information is the building block of KM;
- It is action oriented or application based; and,
- The main drive behind KM is to improve organizational performance.

As the practice of Knowledge Management (KM) across the world, issues' concerning knowledge processes in the library has moved to the forefront. More specifically, the objectives of this paper are formulated as follow:

RQ1. To indicate the type of knowledge management practices in the library.
RQ2. To compare a significant relationship between knowledge creation, knowledge capture, knowledge acquisition and knowledge sharing associate with Knowledge management practice.

RQ3. To recognize a significant influence of the relationship between KM practices and library users' satisfaction.

RELATED WORK

Recently, library has a lot of collections that they need to manage and offers their services and facilities to their users. It is very subjective to say that library could provide their user satisfaction when dealing or borrowing library materials. In an academic institution, library will remain central to the management of scholarly communication. It fulfills the traditional role of information supply or document delivery (Goswami, 2009). McInerney (2002) stated that knowledge is acquired actively and dynamically through sensory stimulation, listening to and observing others, reading, being aware of feelings, life experience, etc. It is this dynamic nature of knowledge that leads to the question of how something in flux, in movement and action, can be managed. With the transformation of knowledge management practice at university libraries, there are several KM practices need to emphasize to demonstrate the significant relation among processes. (Aharony, 2011; Alavi, Kayworth, & Leidner, 2006; Alavi & Leidner, 2001; Gold, Malhotra, & Segars, 2001; Ipe, 2003; Meng & Fei, 2003; Nonaka, Byosiere, Borucki, & Konno, 1994; Nonaka & Takeuchi, 1991; Townley, 2001). Knowledge is composed of the tacit experiences, ideas, insights, values and judgments of individuals as well as for the analysis of information and data. However, it may change direction and bringing more opportunities in libraries to grow or expand (Jawadekar, 2011; Kess, Phusavat, & Takala, 2008). The processes of knowledge coupled with understanding and context in LIS urged on how libraries expand the processes in KM such as knowledge creation, knowledge acquisition, knowledge capture, knowledge sharing, knowledge record, knowledge preserving and so forth. Therefore, the question "how" in this stage is reflected to the libraries itself how they manage the growing or expand of knowledge processes inside the building.

The first practice needs to be elaborated is Knowledge Creation. Maponya (2004) states that knowledge in the context of academic libraries can be created through understanding the user needs and requirements as well as understanding the university's curricula. Recent trends in education emphasizing collaboration and group study are causing a demand for new resources. The need for "knowledge creation" workspace has encouraged librarians, faculty, and computer specialists to work together to provide the necessary technology, information, and services (Gayton, 2008; MacWhinnie, 2003). In fact, the knowledge creating process is a dynamic spiral that moves from the individual to organization and inter-organization dimensions (Kess, Torkko, & Phusavat, 2007). Libraries have always provided study space, and are now including more group study facilities that have technology for access to both physical collection and electronic resources, as well as productivity software that allows students to work together to complete shared assignments. Besides, Lee (2005) and Townley (2001) found that the thrust of knowledge management is to create a process of valuing the organization's intangible assets in order to best leverage knowledge internally and externally. With this regards, a growing amount of information and knowledge involves capturing an organization's goal related knowledge as well as knowledge of it products, customers, competition, and processes, and then sharing that knowledge with the appropriate people throughout the organization. Further, knowledge management seeks to support communities of practice in creating and using knowledge.

Academic libraries as constituents of the parent university should rethink and explore ways to improve their services and become learning organizations in which to discover how to capture and share tacit and explicit knowledge within the library. The changing role of academic librarians as knowledge managers emphasizes the need to constantly update or acquire new skills and knowledge to remain relevant to the today's library environment. Academic libraries may need to restructure their functions, expand their roles and responsibilities to effectively contribute and meet the needs of a large and diverse university community (Maponya, 2004). It is important to note that for organization such as library need to determine who knows what in an organization and how that knowledge can be created and shared. For the purpose of this research, knowledge management is thus, according to Skyrme and Amidon (1997) state that the explicit and systematic management of vital knowledge and its associated processes of creating, gathering, organizing, diffusion, use and exploitation. It requires turning personal knowledge into corporate knowledge that can be widely shared throughout an organization and applied. Maija-Leena and Mirja (2005) stresses that new knowledge is based on an organization's internal information and on knowledge embedded in people/user and organizational structures and processes. This includes tacit and cultural dimensions of organizational knowing that are combined with the external information and knowledge for knowledge creation. However, interaction is a crucial part in these processes, and even internal knowledge can be combined in a totally new manner as well. Besides, it is extremely important to acquire new external information to select and assess it on the basis of its potential usefulness in research. Because university libraries are responsible for creating, acquiring, selecting, recording, preserving and providing access to the latest external knowledge for the whole academic community, they have traditionally had an important role in generative knowledge processes. However, managing all these process requires active collaboration with various user groups.

Knowledge Acquiring is crucial to the success and development of a knowledge-based system in university library. Gorniak-Kocikowska (2001) believes that knowledge has become an instrument which everyone could and should use. Therefore, the trend of libraries seems to be an acquisition of skill related to various aspects of computer technology and almost anything possible. The reason for this that much knowledge is stored in the individual heads and it is often lost if not captured elsewhere. The surest way to avoid collective loss of individual memory is to identify the expertise and the skills of staff and capture it. On top of that, participation of librarians are actually quite interesting in consulting their colleagues in conversion of tacit knowledge into tacit and/or explicit knowledge (Parirokh, Daneshgar, & Fattahi, 2008; Wagner, Otto, & Chung, 2002). Like many things else, it is likely to be a combination of both (tacit/explicit). Thus, libraries as trusted institutions should play an important role in this respect. Therefore, librarians need to be conversant and prepared for active participation in this area (Choy, 2007). As a results, Maija-Leena and Mirja (2005) revealed that university libraries be able to acquire only a small portion of the research literature published in the fields of their home universities. Besides, performing their traditional tasks of providing or access and instruction, libraries negotiate license agreements and form consortia for the acquisition of electronic materials. Academic staffs are the primary producers of electronic teaching materials. However, libraries have an excellent opportunity to support acquisition and access to these materials by digitalizing printed teaching materials and by taking responsibility for the copyright agreements. As experts in a variety of activities related to information and digital materials, librarians can

contribute to the knowledge of lecturers. They can also track down, acquire, and introduce new electronic publications of the latest research findings including those still unknown to academic staff. Librarians should not suppose that academic staff know what librarians do, but they should make every effort to interact with them in order to build good relationships (Ducas & Michaud-Oystryk, 2003). As a result researchers, teachers and students may become more aware of librarians' skills and abilities.

KM is about enhancing the use of organizational knowledge through sound practices of KM and organizational learning (B. Martin, *et al.,* 2006; J. Martin, 2009; Mavodza, 2010). Today, library is fully capable of developing and leveraging critical knowledge to improve their performance. Zack (1999) states that library becoming so complex that knowledge is fragmented, difficult to locate and share, redundant, inconsistent or not used at all. Even knowledge and expertise that can be shared is often quickly made obsolete. According to Williams, *et al.,* (2004) "when information and knowledge flow can be captured, organized and made accessible for reuse, there exists the potential for subsequent creation of new knowledge". Mavodza (2010) and Daneshgar and Bosanquet (2010) states that to facilitate the capturing and transferring of both formal and informal knowledge must through knowledge networking or system. Ani, *et al.,* (2005) found that the use of information technology (computers, telecommunication, reprography, etc.) has a special role in the modernization of library practices. With ICT, such mechanism as electronic cataloguing, electronic online public access catalogues (OPACs), electronic acquisition and serials control, electronic circulation functions, electronic distribution of commercial publications, electronic availability of raw data, multimedia information delivery systems, digitized collections and online textbooks are all now practicable with a higher degree of user satisfaction (Ani, *et al.*, 2005; Siddike, Munshi, & Sayeed, 2011; Tripathy, Patra, & Pani, 2007). Daneshgar and Bosanquet (2010) notes that there is a vast amount of knowledge relating to the Library's customers. Therefore, library management is now exploring more effective methods for organizing knowledge. It is being captured to facilitate knowledge management activities such as evaluating, sharing, and storing of the customer knowledge within the 'library'. The 'Library' expects that knowledge management activities will build a greater understanding of customers and their requirements. Hence, these requirements will hopefully lead to the delivery of more appropriate and timely services towards users' satisfaction. On the other hand, the major challenge of managing knowledge is less its creation and more its capture and integration (T. H. Davenport, De Long, & Beers, 1998). However, sometimes for understanding the user needs and being able to provide adequate services or to match services with suitable philosophies and theories it is crucial for librarians and decision makers within the library to share the knowledge which was captured from the previous phase with some experts in LIS or other related disciplines (Parirokh & Fattahi, 2009). Therefore, above all knowledge has to be captured using proper documentation, through mentoring, training, surveys, etc.

Academic libraries as constituents of the parent university should rethink and explore ways to improve their services and become learning organizations in which to discover how to capture and share tacit and explicit knowledge within the library (Maponya, 2004). The changing role of academic librarians as knowledge managers emphasizes the need to constantly update or acquire new skills and knowledge to remain relevant to the today's library environment. Academic libraries may need to restructure their functions, expand their roles and responsibilities to

effectively contribute and meet the needs of a large and diverse university community (Gurteen, 1999; Hansen, Mors, & Løvås, 2005). According to Gurteen (1999), it is also fundamental about sharing knowledge and putting that knowledge to use. Thus, to create a knowledge sharing culture it needs to encourage people to collaborate and work together more effectively, to collaborate and to share ultimately to make organizational knowledge more productive (Heiman & Nickerson, 2004). Indeed, sharing "tacit knowledge among multiple individuals with different backgrounds, perspectives, and motivations becomes a critical step for organizational knowledge creation to take place" (Nonaka & Takeuchi, 1995). However, it is necessary to establish what sharing knowledge really means (C. K. Lee & Al-Hawamdeh, 2002; Riege, 2005). This implies that not all employees need to share knowledge, because it would not be re-used or applied. A study done by Wabwezi (2011) revealed that knowledge sharing does not stop at contributing to the realization of innovation but also continues after the innovation is achieved to effect its implementation or adoption. The findings of the study also highlighted the factors that affect knowledge sharing at the university and these included organizational culture, incentives for innovation, availability of social meeting places commitment from management and sensitization. A research findings by Teh and Yong (2011) stresses that the practitioners must be aware the presence of individuals' attitude toward knowledge sharing may not lead to intention to share knowledge. Management should create a supportive atmosphere in which knowledge can be shared via effective formal communication (e.g., office's SharePoint portal server) and informal communication (e.g., forum and brainstorming sessions). In fact, facilitating knowledge sharing is a complicated task, as one of the major challenges concern is the willingness of organizational members to share their knowledge with other co-workers. Furthermore, it is also happen among librarians, lecturers and/or management in academic libraries. A survey results by Pengshan and Yongqin (2011) indicates that 85% of respondents reported 'Very Great' or 'Great' satisfaction. The study indicates that library is the core of Information Common (IC), so that library can build such an environment to encourage readers or customers sharing their knowledge. In fact, library also can take advantage of the potential during the course of the knowledge sharing to fulfill their user satisfaction. Nevertheless, there are two novel processes which have to be considered in this study. Considering the importance of Knowledge Record (KRe) and Knowledge Preserving (KPr) in knowledge process, these two processes could be an important variable, which not much discussed in literature. This novel variables hope may help to predict why people choose to record and preserve knowledge in some contexts of KM practices especially at Malaysian universities library toward their users' satisfaction.

Gandhi (2004) found that numerous employees' in organizations were asked to record their tacit knowledge and explicit knowledge (T. H. Davenport, et al., 1998; Dougherty, 1999; Nonaka & Takeuchi, 1995), whereby they have to write down step-by-step for everything they did. However, the main issue to be consider is that do they (i.e., individual or employee) really care to record their tacit and explicit knowledge?. Several employees were forced by organization themselves to record knowledge (Smiraglia, 2002) they had internalized as experience or memory. Knowledge of how records are used is therefore also important to be able to develop and design (Borglund, 2008; Borglund & Öberg, 2008; Yeo, 2005). As such, successful KM initiatives could help organizations to establish their internal benchmarks, identify and record best practices, and create an environment of continuous learning. KM systems implemented in libraries so far have not achieved these goals. Richardson (1995) agree that librarians need to

learn from the process and avoid repeating mistakes, it is vital to record what worked, what did not work, which steps in the process were useful, and what would they do differently next time. According to Al-Hawamdeh (2002) not all types of knowledge can be recorded and codified as information. Branin (2003) agreed that librarians need to extend their expertise in creating, acquisition, dissemination selecting, organizing, record, preserving and etc. (Anjanappa, Kattimani, & Jange, 2009; Cho, *et al*., 2009; Delsaerdt, 2008) whereby they must willing to get outside the routines and the walls of the traditional library and work more directly with technologists, faculty, and students. Therefore, when discuses about knowledge management practice, it is clearly dealing with a set of complex issues that are interrelated and cannot be segmented (Al-Hawamdeh, 2002). A study done by Garcia (2011) revealed that the business of libraries is facilitating knowledge transfer through the effective preservation and organization of public documents and public knowledge records to ensure that it social utilization so knowledge is effectively transferred. For that, they provide monitoring, storage, retrieval, and users' information empowerment services, and have a managerial structure, to ensure the appropriate leadership, planning, and administration of this. The important point to note by Harries (2009) is that, here (i.e. Library) dealing not just with records of actions, but also with knowledge processes and information, given meaning through content and context, and put into action working. According to author, "… If we believe that a core principle of records is that they improve accountability and good governance, then we need to consider how records management can account for, and incorporate, this social dimension and its role in the social production of knowledge. Within and between different professional communities; processes which both create and use those records". Nevertheless, the approach for records created in the course of day-to-day business of the universities was to stored and kept in hard copies as evidence of an action, decision or process. The process of record keeping provides a framework for keeping, maintaining and providing for the disposition of records and what is contained in them. Therefore, the process intended to benefit all members of staff by facilitating continuity and evaluation of services and preserving privacy (Egwunyenga, 2009).

It is important to state that Knowledge Preservation also has significant with knowledge management practice in the knowledge process. Haahr (2002) states that the preservation of knowledge, in the form of libraries allowed such communities to 'exist' despite the temporal separation of some of the members. To preserving the knowledge in the library (Dougherty, 1999), there has to be a voluntary action on behalf of the individual. Anderson (1996) found that university (i.e. Academic library) could contribute to the operational of the service through purchasing and operating a portion of the hardware and software required for the service and/or via financial support towards the preservation of key material, such as certain books and journals, much like the collections now found in physical form in university libraries are built via the purchase of selected books and journals. The process of knowledge capture, sharing, record and preserving approach is technology-dominated (Hildreth & Kimble, 2002). With the increased interest in knowledge preservation that cannot be captured and recorded, a number of researchers (e.g. (Coffman, 2010; Igbeka & Ola, 2010; Tasmin & Woods, 2008) have begun to realize that library management has poses significant challenges and the existing approaches to KM are not adequate. A study done by Ismail (2006) indicates that library preservation programs take into consideration factors such as the physical environment in which information resources are housed; disaster control; pest control; handling of the resources by library staff and users;

access control; conservation; reformatting; routine maintenance; library security and reader education. Librarians must preserve for posterity and therefore, good collections:

- Attract scholars who may come to the university to teach, for sabbatical or pursue higher degrees;
- Attract requests for document supply;
- Attract gifts from scholars and book collectors because of the confidence in the Library's preservation and access policies; and
- Make librarians proud and happy that they have discharged their duties and responsibilities well.

Nevertheless, Preservation is a professional and management responsibility. There is no access without preservation and libraries can only create and maintain bibliographic records for materials that are available. Catalogue records do not mean a thing, if libraries cannot provide the materials they describe. Nothing can be more frustrating to the researcher than to spend time at the catalogue noting call numbers but not being able to get the materials when they go looking at the stacks. They will vent their frustrations on library staff and there is nothing that library staff can do except to apologize and offer to search for the materials that they themselves fear are no longer in the library (Ismail, 2006).

Recently, there are many knowledge processes that have been introduced by prior researchers. However, only six knowledge processes were selected based on a comprehensive literature review such as Knowledge Creating (KCr), Knowledge Acquisition (KAc), Knowledge Capturing (KCa) and Knowledge Sharing (KSh). In fact, another two novel processes, which found to fulfill the gaps are Knowledge Preserving (KPr) and Knowledge Record (KRe). Furthermore, the linkages of KM practice (i.e. KCr, KAc, KCa, KSh, KRe and KPr) are becoming a main variables contributing to KM Practice against Library Users' Satisfaction.

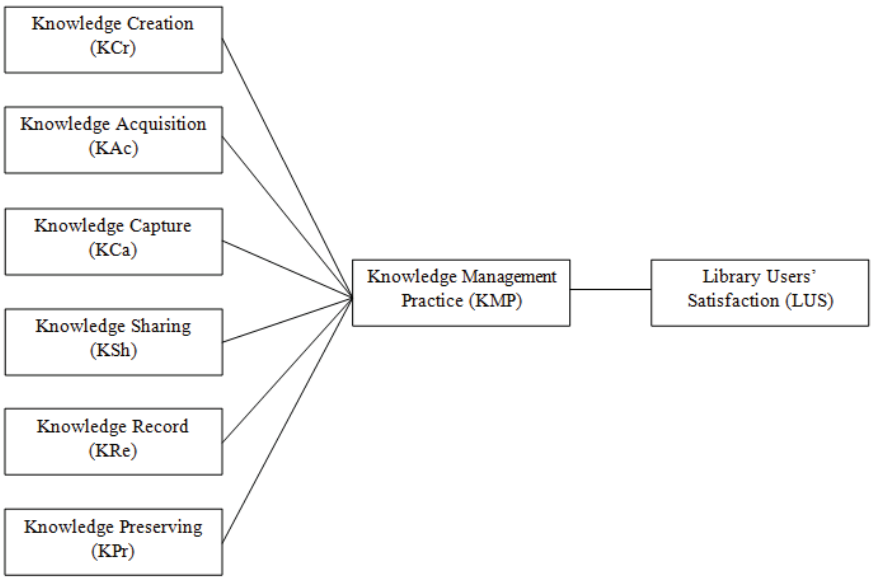


Figure 1. Theoretical Framework of KM Processes

The novelty classifications of KM process allow researchers to compare and analyze the process when dealing with KM process to fulfill their user satisfaction in the library. Karadsheh, *et al.* (2009) stated that many of the model are broad enough to provide a complete analysis of the knowledge flow in the organization. Therefore, the proposes of novelty KM process could improve the existing KM processes to provide the Knowledge Creating (KCr), Knowledge Acquisition (KAc), knowledge Capturing (KCa) and Knowledge Sharing (KSh), Knowledge Record (KRe) and Knowledge Preserving (KPr) has illustrated in figure 1. Therefore, all six processes need to be linked with KM practice to perceive whether it has a significant impact against Library Users' Satisfaction (LUS) at university libraries. Nevertheless, these processes need to be in place or cultivated strongly for the implementation of Knowledge Management practices to be a success (Al-Hawamdeh, 2002).

METHODS AND RESULTS

The selected population for this study was Malaysian University Libraries. The sample size of this pilot test is approximately 35 PhD candidates who are the lead user in Malaysian University Libraries. A total number of 35 set of questionnaires were distributed randomly to the PhD students who visited the library for a period of two weeks. This implies that each student who went to the library has the same chance of being selected to answer the questionnaire (Sekaran, 2003). Respondents were requested to return the filled-in questionnaires to the library counter. A total of 35 filled-in questionnaires were returned which showed an overall response rate of 100%.

Almost all lead users are PhD candidates. Most of the lead users answered to the pilot survey questionnaires 51.4% were male while 48.6% of them were female. This shows that most of the lead user should have a good knowledge about library such as Knowledge Creating (KCr),

Knowledge Acquisition (KAc), Knowledge Capturing (KCa), Knowledge Sharing (KSh), Knowledge Record (KRe) and Knowledge Preserving (KPr). The result indicates that 100% of the lead user rated "Yes" that KM Practice should be applied in the library. The 5-point Likert scale was divided into three ranges based on Tasmin and Woods (2007). The ranges for the extent are Low (1.0 to 2.3), Medium (2.4 to 3.7) and High (3.8 to 5.0). Figure 2 shows a higher mean score analysis, which is Knowledge Acquisition (4.21) were rated in the first place types of KM practice most applicable in the library. While, there is 4.05 of Knowledge Capture (KCa) and 4.09 is Knowledge Preserving (KPr). However, 3.95 is Knowledge Creation (KCr) was rated in the fourth place, While 3.63 is Knowledge Sharing (KSh) in the fifth and 3.59 is Knowledge Record (KRe) were the last. In sum, it was discovered that the extent of KM practices was at a higher level at Malaysian University Libraries.

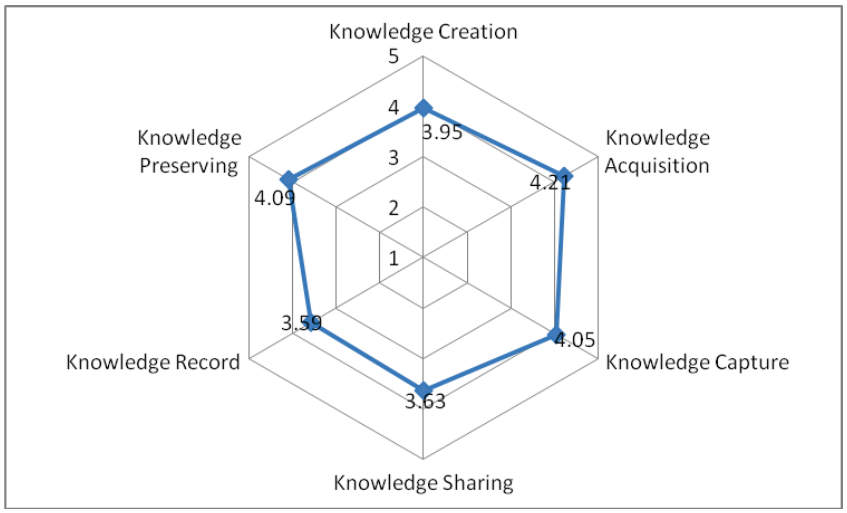


Figure 2. Types of processes in KM practice

Figure 3 shows overall mean of highly ranked journals (continuous line) which are high on elements of PhD candidates know that access to highly ranked journals is important in their study field with mean score value of 4.71. This signifies that highly ranked journals was very important to the Lead User (PhD candidates) as their core references or literature in research. Based on the survey, it is noticeable that they know how to access the highly ranked journals within my study field in time with mean score value of 3.71. This poses important interpretation that PhD candidates are knowledgeable about how to make use of high ranked journals in their study. Also, it shows that they are scholarly and knowledgeable in this PhD stage.

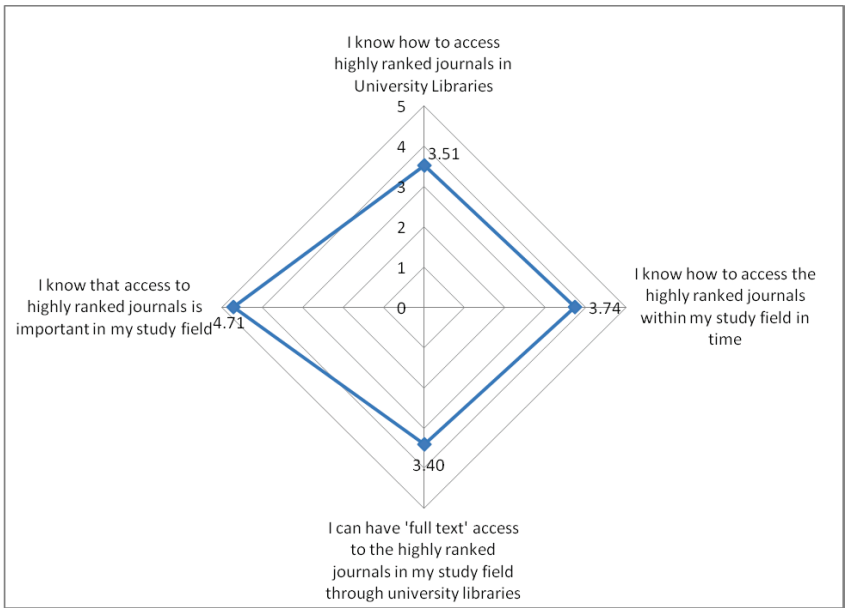


Figure 3. Overall Mean of highly ranked journals

Figure 4 indicates that only 9 out of 20 Malaysian Universities participated in this pilot survey. The majority of the Lead Users 34.3% were from Universiti Tun Hussein Onn Malaysia (UTHM), 25.7% were from Universiti Utara Malaysia (UUM). They were followed by Universiti Putra Malaysia (UPM) 14.3%, Universiti Kebangsaan Malaysia (UKM) 8.6% and Universiti Teknologi Malaysia 5.7%. Others, Universiti Sains Malaysia (USM), Universiti Teknologi MARA (UiTM), Universiti Islam Antarabangsa Malaysia (UIAM) and Universiti Malaysia Sarawak (UNIMAS) were 2.9%.

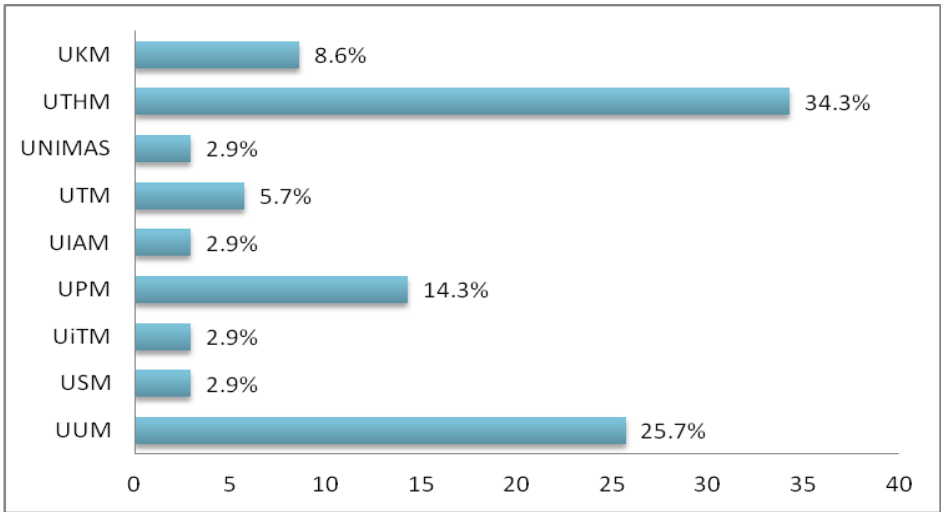


Figure 4. Malaysian Universities

Table 1 indicates that reliability assessment was made. Cronbach's Alpha coefficients were computed for each factor to access reliability of measurement. The coefficients of Alpha for all factors indicated values raging from 0.806 to 0.911. Hair, *et al.* (2006) stated that Cronbach's Alpha values of 0.60 to 0.70 are regarded as "the lower limit of acceptability". Thus, this study showed that all of the scale reliabilities in pilot test results were above accepted range of the threshold values. In fact, the questionnaire was pre-tested on 35 PhD candidates at Malaysian University Libraries to evaluate the questionnaire's validity with regard to clarity, bias, ambiguous questions, and relevance to the respective libraries.

Table 1. Reliability Analysis of Each Factor

Knowledge Management Processes	Cronbach's Alpha	No. of Indicators
1. Knowledge Creation (KCr)	0.825	6
2. Knowledge Acquisition (KAc)	0.841	5
3. Knowledge Capture (KCa)	0.817	5
4. Knowledge Sharing (KSh)	0.806	6
5. Knowledge Record (KRe)	0.911	6
6. Knowledge Preserving (KPr)	0.870	5
7. Library Users Satisfaction (LUS)	0.909	10

Table 2 indicates the correlation coefficient between Knowledge Management Practice (KMP) overall and Library Users' Satisfaction (LUS) is 0.846. In facilitating the interpretation, the coefficient of determination is found. This is simply the square of correlation coefficient implied by 100. This shows that there is a positive and significant relationship between the level of Knowledge Management Practice (KMP) overall and Library Users' Satisfaction (LUS). Thus, the significant level is 0.000 which is lower than the stated significance level 0.01. Therefore, this suggests that the relationship is statistically significant. The extent of correlation coefficient refers to Cohen and Holliday (1982).

Table 2. Overall correlations between KM Practice and Library User Satisfaction (LUS).

		LUS	KMP Overall
LUS	Pearson Correlation	1	.846**
	Sig. (2-tailed)		.000
	N	35	35
KMP Overall	Pearson Correlation	.846**	1
	Sig. (2-tailed)	.000	
	N	35	35

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 5 depicts KM practices at Malaysian Non Research University (i.e. UTHM, UUM, UiTM, UNIMAS) and Research University (i.e. UKM, UPM, USM, UTM, UIAM) which shifts at higher scores on elements process of Knowledge Creation (KCr), Knowledge Acquisition (KAc), Knowledge Capture (KCa), Knowledge Sharing (KSh), Knowledge Record (KRe) and Knowledge Preserving (KPr). Comparisons mean score value for Research University elements is 4.03 (Knowledge Creation), 4.35 (Knowledge Acquisition) and 4.01 (Knowledge Capture) which is considered high at 5-points Likert scale. As such, Non Research University (NRU) mean score value is 4.12 (Knowledge Creation), 4.03 (Knowledge Acquisition), 4.00 (Knowledge Capture) and (Knowledge Preserving) which is considered high at 5-points Likert scale. This signifies that RU and NRU have values efforts to compete each others to get higher ranking in Malaysia universities. This is attributed to the fact that actual KM practices are high in practice as shown minor gap between continuous and broken lines (Tasmin, A Rahman, A Hamid, & Che Rusuli, 2010).

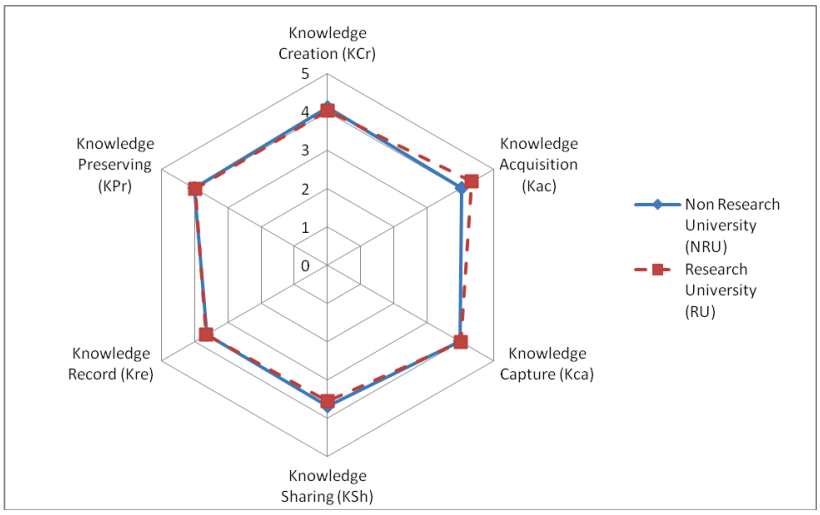


Figure 5. Comparison KM Processes among Non Research University (NRU) and Research University (RU)

It is noticeable, as shown in Figure 6 below, that elements of KM practices are quite in a close-call when comparing between the non-research and research universities. However, it is a noteworthy differential gaps at namely two elements of KM practices; KAc and KSh. It is seen that Kac for among RU is higher than those of Non-RU. One could make sense of this significant gap with the fact that most RUs are of intensively pursuing into high performance research with higher capacity of financial support, especially from the ministerial level. As such, it is not surprising the fact that KAc at RUs is higher that KAc of that Non-RUs, with a gap value of 0.32. This also signifies that RUs are at the forefront of knowledge search frontier, pursuing new areas of potential research such as linking their research with finer research institutions in the developed countries, patenting their own research outcomes and perhaps purchasing potential technology rights from other institutions. It is generally acceptable, in Malaysia universities' setting, that such KAc approaches are quite normally done in UKM, UPM and USM.

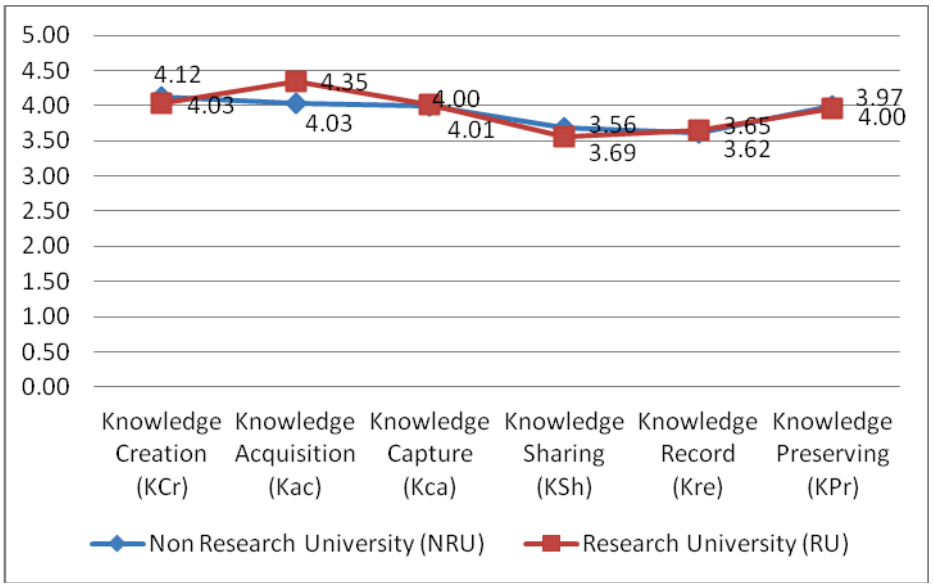


Figure 6. Trend of the KM practices at Malaysian University Libraries

However, it is interesting to notice, from Figure 6, that at element of KSh, Non-RUs are performing slightly better than the RUs. It is shown that Non-RUs are better-off at "Sharing" knowledge internally and/or sharing knowledge with other Non-RUs. One logical explanation for such a minute but significant difference with the fact that Non-RUs, in Malaysia, tend to share knowledge with each other. This perhaps, is due to the syndrome of feeling that Non-RUs must collaboratively work together to compete with better-off funded research by the research universities. In actual fact, this scenario is translated well in reality at Malaysian varsities, in which one can observe that there is good cross collaboration between UTHM, UTem and UMP in the research areas of environmental engineering and sustainable manufacturing. Based on numerical results, in 2012, such collaborative cross-nonRUs research projects have secured national grants as much as more than RM2 millions, reported by MTUN research committee. It depicts that Non-RUs tend to team-up forces (KSh) with its same-class varsities to secure better research grants in order to compete or survive against already established research varsities, in Malaysia.

DISCUSSION

This article focuses mostly on the KM processes such as Knowledge Creation (KCr), Knowledge Acquisition (KAc), Knowledge Capture (KCa), Knowledge Sharing (KSh), Knowledge Record (KRe) and Knowledge Preserving (KPr). Respondents in this study were specifically selected and PhD candidates are known as Lead User. The types of KM processes indicate that Knowledge Acquisition (KAc) is the most significantly rated by lead users, with value of 4.21. The result shows that the library has been regarded as a treasure house that attracted countless individuals for realizing their own learning and knowledge acquisition (Daneshgar & Parirokh, 2007; Lin, Gu, & Kawasaki, 2004; Ogunsola, 2011). At the library, individuals demand knowledge, and they need flexible and diversified resources. The library can utilize its abundant

amount of resources, advanced technology and facilities, and its understanding of users' demands to develop campaigns that support individuals' learning. The library has been regarded as a knowledge navigation station, because it can hold events such as exhibitions for newly published books, educational conferences, seminars, book reviews and discussion meetings.

Moreover, Knowledge Record (KRe) and Knowledge Preserving (KPr) were asked whether good to be practiced in the university libraries. The result indicates that these two variables were rated 'agree' and 'significantly important' by lead users. It shows that Knowledge Record (KRe) and Knowledge Preserving (KPr) could contribute as new processes in KM practice at university libraries. Knowledge record and knowledge preserving exists in the library but did not offers to the lead user but more to products and services in the library. However, the libraries should inform and offers users these two processes because it deals with the products and services. When user knows these two processes, it appears that the library takes into account when users requests for this knowledge. Therefore, these two processes need to address and link into KM practice as depicted in Figure 1. This result discusses about Research University (RU) and Non-Research University (NRU) as depicted in Figure 4 and Figure 5. As research universities (Figure 5), an interesting result showed that such large public institutions as UKM, USM, UTM, UKM and UIAM have applied KM processes in the level of management especially at university libraries. The result indicates that these knowledge processes applied in order to become Research University. It shows that Research University libraries have a strong products and services that contribute to higher level of user satisfaction.

For Non-Research University (Figure 6), the results show moderate of every each of KM processes. This indicates that university such as UTHM, UUM, UiTM and UNIMAS need to enhance or increase their products and services to achieve higher level of user satisfaction if they want to become a Research University (RU). Level of management especially library management needs to play role to help Non-Research University (NRU) align their dreams to become Research University (RU) in the future. The most interesting finding of this research was the statistical result of linkage between KM practice and Library Users' Satisfaction. In Pearson correlation indicates that KM practice has a significant correlation with Library Users' Satisfaction as depicted in Table 2. It shows that KM processes applied in the library need to provide satisfaction to their users when they are using products and services. In fact, all product and services provide by the library must contribute to a high satisfaction to their users. If not, they will not enjoy visits to the library and utilize product and services. Therefore, libraries need to maintain their user satisfaction with further planning and activities which could raise levels of user satisfaction every year.

CONCLUSION

This study highlights the relationship between KM practice and Library Users' Satisfaction which is positive and significant. This article has concentrated on examining this linkage between KM practice and Library Users' Satisfaction at Malaysian university libraries. Moreover, it reveals what the most effective KM processes and Library Users' Satisfaction are for this purpose. Depending on the KM practice being considered, the type of KM processes varies. So, the role played by KM practices is really significant for university libraries seeking to

gain a competitive advantage within them. The results of this study would recommend university libraries for investing efforts in the KM processes. Although, implementing the KM processes especially Knowledge Record (KRe) and Knowledge Preserving (KPr) would increase more internal library services, but it might play a substantial role for its survival. The university libraries require to improve their IT bases to be effective in determining product and service documents and developing their databases which ultimately facilitate the KM process of KM practice in the university libraries. With this increased attention comes an opportunity for academicians and researchers to participate in examining and refining new practices and processes as they emerge. The finding of this research proves that there is a positive and strong relationship between Knowledge Management Practice (KMP) and Library Users' Satisfaction (LUS). Therefore, future research has to be conducted to find out the linkage between KM practice and Library Users' Satisfaction using Structural Equation Modeling (SEM) for stronger structural point of view. In addition, this research can also be executed in other countries to explore the status of knowledge management practices in other parts of the world.

ACKNOWLEDGEMENT

The authors would like to acknowledge his PhD supervisor for guiding this paper. The authors are also indebted to the prior literature research that has been made in any anonymous journal referees related to Knowledge Management (KM) and Library and Information Sciences (LIS) environment. The author also wishes to thank the editor for extensive assistance in the final revision of the paper to be published.

REFERENCES

8. Aharony, N. (2011). Librarians' Attitudes toward Knowledge Management. *College & Research Libraries, 72*(2), 111-126.
9. Al-Hawamdeh, S. (2002). Knowledge management: re-thinking information management and facing the challenge of managing tacit knowledge. *Information research, 8*(1), 8-1. Retrieved from http://informationr.net/ir/8-1/paper143.html
10. Alavi, M., Kayworth, T. R., & Leidner, D. E. (2006). An empirical examination of the influence of organizational culture on knowledge management practices. *Journal of management information systems, 22*(3), 191-224.
11. Alavi, M., & Leidner, D. E. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS quarterly*, 107-136.
12. Anderson, R. (1996). *The eternity service.* Paper presented at the Proceedings of Pragocrypt '96, Prague, CTU Publishing House.
13. Ani, O. E., Esin, J. E., & Edem, N. (2005). Adoption of information and communication technology (ICT) in academic libraries: a strategy for library networking in Nigeria. *Electronic Library, The, 23*(6), 701-708.
14. Anjanappa, M., Kattimani, M., & Jange, S. (2009). Trends in ICT for Librarian 2.0: Open Courseware, Open AccessJournals and Digital Library Initiatives.
15. Borglund, E. A. M. (2008). *Design for Recordkeeping: Areas of Improvement.* Doctoral Thesis 52, Mid Sweden University, Sundsvall.

16. Borglund, E. A. M., & Öberg, L. M. (2008). How are records used in organizations? *Information research, 13*(2), 2. Retrieved from http://informationr.net/ir/13-2/paper341.html
17. Branin, J. J. (2003). Knowledge management in academic libraries. *Journal of library administration, 39*(4), 41-56.
18. Brendan, L. (1999). Knowledge management, librarians and information managers: fad or future? *New Library World, 100*(6), 245-253.
19. Cho, A., Doyle, A., Giustini, D., Lawson, K., Lee, T., Naslund, J. A., et al. (2009). "Dimensions of Responsive Multicultural Library Services at the University of British Columbia (UBC): Successes and Challenges". 1-22.
20. Choy, F. C. (2007). Libraries and librarians–what next? *Library Management, 28*(3), 112-124.
21. Coffman, E. J. (2010). Is Justified Belief Knowledge? Critical Notice of Jonathan Sutton, Without Justification. *Philosophical Books, 51*(1), 1-21.
22. Cohen, L., & Holliday, M. (1982). Statistics for social sciences. *Rural health in Jamaica: examining and refining the predictive factors of good health status of rural residents. Rural and Remote Health, 9*, 1116.
23. Conklin, J. (1996). Designing organizational memory: Preserving intellectual assets in a knowledge economy. *Group Decision Support Systems, 1*, 362.
24. Daneshgar, F., & Bosanquet, L. (2010). Organizing Customer Knowledge in Academic Libraries. *Electronic Journal of Knowledge Management, 8*(1), 21-32.
25. Daneshgar, F., & Parirokh, M. (2007). A knowledge schema for organisational learning in academic libraries. *Knowledge Management Research & Practice, 5*(1), 22-33.
26. Davenport, E., & Hall, H. (2002). Organizational knowledge and communities of practice. *Annual review of information science and technology, 36*(1), 171-227.
27. Davenport, T. H., De Long, D. W., & Beers, M. C. (1998). Successful knowledge management projects. *Sloan management review, 39*(2), 43-57.
28. Davenport, T. H., & Prusak, L. (2002). Working knowledge: How organizations manage what they know. *Boston MA, USA: Harvard Business*.
29. Delsaerdt, P. (2008). From Légère Teinture to Central Place: A Revaluation of Book and Library History within Library and Information Science Programmes. *Library History, 24*(2), 143-151.
30. Dougherty, V. (1999). Knowledge is about people, not databases. *Industrial and Commercial Training, 31*(7), 262-266.
31. Ducas, A. M., & Michaud-Oystryk, N. (2003). Toward a New Enterprise: Capitalizing on the Faculty–Librarian Partnership. *College & Research Libraries, 64*(1), 55-74.
32. Egwunyenga, E. J. (2009). Record Keeping in Universities: Associated Problems and Management Options in South West Geo-Political Zone of Nigeria. *Int. J. Educ. Sci, 1*, 109-113.
33. Feng, L., Jeusfeld, M. A., & Hoppenbrouwers, J. (2001). Towards knowledge-based digital libraries. *ACM SIGMOD Record, 30*(1), 41-46.
34. Foo, S., Chaudhry, A., Majid, S., & Logan, E. (2002). *Academic libraries in transition: Challenges ahead*. Paper presented at the Academic Library Seminar.
35. Gandhi, S. (2004). Knowledge management and reference services. *The Journal of Academic Librarianship, 30*(5), 368-381.

36. García-Marco, F. J. (2011). Libraries in the digital ecology: reflections and trends. *Electronic Library, The, 29*(1), 105-120.
37. Gayton, J. T. (2008). Academic Libraries. *The Journal of Academic Librarianship, 34*(1), 60-66.
38. Gold, A. H., Malhotra, A., & Segars, A. H. (2001). Knowledge management: An organizational capabilities perspective. *Journal of management information systems, 18*(1), 185-214.
39. Gorniak-Kocikowska, K. (2001). Revolution and the Library. *Library trends, 49*(3), 454-470.
40. Goswami, P. (2009). *Academic librarianship in India: Towards exploring strategic intent and core competencies in the present era*.
41. Gurteen, D. (1999). Creating a knowledge sharing culture. *Knowledge Management Magazine, 2*(5), 1-4.
42. Haahr, M. (2002). Information jockey: The dubious role of the 21st-century academic. *SOUTHERN REVIEW-ADELAIDE-, 35*(2), 71-87.
43. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate Data Analysis*. New Jersey: Pearson University Press.
44. Hammer, M., Leonard, D., & Davenport, T. (2004). Why don't we know more about knowledge? *MIT Sloan Management Review, 45*, 14-18.
45. Hansen, M. T., Mors, M. L., & Løvås, B. (2005). Knowledge sharing in organizations: Multiple networks, multiple phases. *The Academy of Management Journal*, 776-793.
46. Harries, S. (2009). Managing records, making knowledge and good governance. *Records Management Journal, 19*(1), 16-25.
47. Heiman, B. A., & Nickerson, J. A. (2004). Empirical evidence regarding the tension between knowledge sharing and knowledge expropriation in collaborations. *Managerial and Decision Economics, 25*(6-7), 401-420.
48. Hildreth, P. M., & Kimble, C. (2002). The duality of knowledge. *Information research* Retrieved 1, 8, from http://informationr.net/ir/8-1/paper142.html
49. Igbeka, J., & Ola, C. O. (2010). The Need for Digitization of Special Library Materials in Nigerian University Libraries. from http://www.worlib.org/vol18no1/igbekaprint_v18n1.shtml
50. Ipe, M. (2003). Knowledge sharing in organizations: A conceptual framework. *Human Resource Development Review, 2*(4), 337-359.
51. Ismail, H. I. (2006). Access and Preserve. *Kekal Abadi, 25*(1/2), 1-5.
52. Jain, P. (2007). An empirical study of knowledge management in academic libraries in East and Southern Africa. *Library review, 56*(5), 377-392.
53. Jawadekar, W. S. (2011). *Knowledge management*: New Delhi : McGraw-Hill.
54. Karadsheh, L., Mansour, E., Alhawari, S., Azar, G., & El-Bathy, N. (2009). A theoretical framework for knowledge management process: towards improving knowledge performance. *Communications, 7*.
55. Kess, P., Phusavat, K., & Takala, J. (2008). Managing external knowledge: framework for organisational life cycles. *International Journal of Innovation and Learning, 5*(3), 255-265.
56. Kess, P., Torkko, M., & Phusavat, K. (2007). *Knowledge transfer for effective outsourcing relationships*.

57. Lee, C. K., & Al-Hawamdeh, S. (2002). Factors impacting knowledge sharing. *Journal of Information & Knowledge Management, 1*(01), 49-56.
58. Lee, H. W. (2005). Knowledge Management and the Role of Libraries. *Knowledge Management and the Role of Libraries.* Retrieved August 18, 2012, from http://www.white-clouds.com/iclc/cliej/cl19lee.htm
59. Lin, H., Gu, Z. Y., & Kawasaki, Y. (2004). Shanghai public libraries and lifelong education. *Lifelong education and libraries, 4*, 135-172.
60. MacWhinnie, L. A. (2003). The information commons: the academic library of the future. *Portal-Libraries and the Academy, 3*(2), 241-258.
61. Maija-Leena, H., & Mirja, I. (2005). Knowledge processes: A strategic foundation for the partnership between the university and its library. [DOI: 10.1108/01435120410609743]. *Library Management, 26*(6), 324-335.
62. Maponya, P. M. (2004). Knowledge management practices in academic libraries: a case study of the University of Natal, Pietermaritzburg Libraries. *SCECSAL Proceedings*.
63. Martin, B., Hazeri, A., & Sarrafzadeh, M. (2006). Knowledge management and the LIS professions: investigating the implications for practice and for educational provision. *Australian Library Journal, 55*(1), 12.
64. Martin, J. (2009). The art of librarianship. *College & Research Libraries News, 70*(11), 652-654.
65. Mavodza, J. (2010). *Knowledge management practices and the role of an academic library in a changing information environment: the case of the Metropolitan college of the New York.*
66. McInerney, C. (2002). Knowledge management and the dynamic nature of knowledge. *Journal of the American Society for Information Science and Technology, 53*(12), 1009-1018.
67. Meng, L., & Fei, G. (2003). Why Nonaka highlights tacit knowledge: a critical review. *Journal of Knowledge Management, 7*(4), 6-14.
68. Nonaka, I., Byosiere, P., Borucki, C. C., & Konno, N. (1994). Organizational knowledge creation theory: a first comprehensive test. *International Business Review, 3*(4), 337-351.
69. Nonaka, I., & Takeuchi, H. (1991). The knowledge-creating company. *Harvard business review, 85*(7/8), 162.
70. Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*: Oxford University Press, USA.
71. Ogunsola, L. (2011). The Next Step in Librarianship: Is The Traditional Library Dead? *Library Philosophy and Practice*(1), 42.
72. Parirokh, M., Daneshgar, F., & Fattahi, R. (2008). Identifying knowledge-sharing requirements in academic libraries. *Library review, 57*(2), 107-122.
73. Parirokh, M., & Fattahi, R. (2009). A theoretical framework for development of a customer knowledge management system for academic libraries. *Spanish Journal of Agricultural Research*, 1-16.
74. Pengshan, Y., & Yongqin, T. (2011, 15-17 July 2011). *The model of tacit knowledge sharing and the importance of library in the course.* Paper presented at the Software Engineering and Service Science (ICSESS), 2011 IEEE 2nd International Conference on.
75. Richardson, J. V. (1995). *Knowledge-based systems for general reference work: Applications, problems, and progress*: Academic Press, Inc.

76. Riege, A. (2005). Three-dozen knowledge-sharing barriers managers must consider. *Journal of Knowledge Management, 9*(3), 18-35.
77. Roknuzzaman, M., & Umemoto, K. (2009). *Knowledge management education in library and information science schools: an exploratory study*.
78. Rowley, J. (1999). What is knowledge management? *Library Management, 20*(8), 416-420.
79. Sarrafzadeh, M., Martin, B., & Hazeri, A. (2010). Knowledge management and its potential applicability for libraries. *Library Management, 31*(3), 198-212.
80. Sekaran, U. (2003). Research methodology for business: New York: John Wiley & Sons, Inc.
81. Siddike, A. K., Munshi, N., & Sayeed, A. (2011). The Adoption of Information and Communication Technology (ICT) in the University Libraries of Bangladesh: An Exploratory Study.
82. Skyrme, D., & Amidon, D. (1997). The knowledge agenda. *Journal of Knowledge Management, 1*(1), 27-37.
83. Smiraglia, R. P. (2002). Further reflections on the nature of 'A Work': An introduction. *Cataloging & classification quarterly, 33*(3-4), 1-11.
84. Tandale, P. G., Sawant, P. G., & Tandale, G. P. (2011). Knowledge Management and the Role of Libraries. *Proceedings of the 5th National Conference; INDIACom-2011*.
85. Tasmin, R., A Rahman, N., A Hamid, N., & Che Rusuli, M. S. (2010). Knowledge management orientation at public and private universities in Malaysia: an empirical overview of organizational knowledge practices.
86. Tasmin, R., & Woods, P. (2007). Relationship between corporate knowledge management and the firm's innovation capability. *International Journal of Services Technology and Management, 8*(1), 62-79.
87. Tasmin, R., & Woods, P. (2008). Knowledge management and innovation in Peninsular Malaysia.
88. Teh, P. L., & Yong, C. C. (2011). Knowledge sharing in is personnel: organizational behavior's perspective. *Journal of Computer Information Systems, 51*(4), 11.
89. Townley, C. T. (2001). Knowledge management and academic libraries. *College & Research Libraries, 62*(1), 44-55.
90. Tripathy, J. K., Patra, N. K., & Pani, M. R. (2007). Leveraging knowledge management: challenges for the information professional. *DESIDOC Journal of Library & Information Technology, 27*(6), 65-73.
91. Wabwezi, A. (2011). *The role of knowledge sharing in fostering innovation in higher education: a case study of Tallinn University.* Høgskolen i Oslo. Avdeling for journalistikk, bibliotek-og informasjonsvitenskap.
92. Wagner, W., Otto, J., & Chung, Q. (2002). Knowledge acquisition for expert systems in accounting and financial problem domains. *Knowledge-Based Systems, 15*(8), 439-447.
93. Wen, S. (2005). Implementing knowledge management in academic libraries: a pragmatic approach. *Ann Arbor*, 1001, from http://www.white-clouds.com/iclc/cliej/cl19wen.htm
94. White, T. (2004). *Knowledge management in an academic library case study: KM within Oxford University Library Services (OULS)*.
95. Wiig, K. M. (1997). Knowledge management: an introduction and perspective. *Journal of Knowledge Management, 1*(1), 6-14.

96. Williams, A., Giuse, N., Koonce, T., Kou, Q., & Giuse, D. (2004). Using knowledge management practices to develop a state-of-the-art digital library. *MedInfo, 11*(1), 99-103.
97. Yeo, G. (2005). Understanding users and use: a market segmentation approach. *Journal of the Society of Archivists, 26*(1), 25-53.
98. Zack, M., McKeen, J., & Singh, S. (2009). Knowledge management and organizational performance: an exploratory analysis. *Journal of Knowledge Management, 13*(6), 392-409.
99. Zack, M. H. (1999). Managing codified knowledge. *Sloan management review, 40*(4), 45-58.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

AN EMPIRICAL STUDY OF USERS' CONTINUANCE INTENTION AND WORD OF MOUTH TOWARD SNA (SOCIAL NETWORK APP)

Huei-Hsia Hsu, Department of Information Management, China University of Science and Technology, Taipei, Taiwan

Chia-Cheng Chang, MS program in The Graduate School of Business and Management, China University of Science and Technology, Taipei, Taiwan

Tzu-Hong Lin, PhD student of Management College, National Taiwan University of Science and Technology, Taipei, Taiwan

ABSTRACT

There has been a long-running war going on over the mobile application and it has attracted increased attention in recent years. However, there has been little research on Social Network App (SNA). We try to extend the Expectation-Confirmation Model with the Technology Acceptance Model as the theoretical model to explain the users' continuance intention and word of mouth on SNA usage. Hypothesis testing was performed using SmartPLS on data collected with 204 Apps users. The results show that satisfaction was affected by perceived usefulness, perceived ease of use, confirmation, and the continuance intention and word of mouth were influenced by satisfaction. Theoretical and practical implications were discussed.

Keywords: Social Network App, word of mouth, continuance intention, satisfaction, perceived ease of use, perceived usefulness, confirmation

BRIEF PROFESSIONAL BIOGRAPHY

Huei-Hsia Hsu is Associate Professor of Information Management at China University of Science and Technology. Her papers have appeared in Omega and International Journal of Mobile Communications. Her research interests are in electronic commerce, mobile commerce, social networking, and management information systems.

Chia-Cheng Chang received his BS degree in Finance, from China University of Science and Technology, in 2011 and now he is in MS program in The Graduate School of Business and Management from China University of Science and Technology. His research interests include electronic commerce, mobile commerce, and social networking.

Tzu-Hong Lin is a PhD student of Management College at the National Taiwan University of Science and Technology and with more 15 years working experience in telecom and internet relevant field. He received a MBA degree in Texas A&M University in 1992. His research interests are in social networking, mobile commerce and e-commerce.

INTRODUCTION

Since 2007, more than 500 million smartphones have been activated. By the end of 2012, the cumulative number of smartphone devices activated will surge past 1 billion. According to IDC, over 3 billion smart-phone devices were adopted between 2007 and 2010, making the rate of smartphone device adoption more than four times faster than that of personal computers (Newark-French, 2012). The mobile application (App) revolution has changed the way software is distributed and used among consumers. Over 40 billion applications have already been downloaded from the App Store. People are spending ever more time in App. With App usage soaring, Social Network App (SNA) service captures the significant majority of consumers' time. App users spend more and more time of their day using Social Network App (SNA) (Newark-French, 2012).

In our study we attempted to explain the word of mouth and continue intention to SNA usage. We based our framework on Expectancy Confirmation Model (ECM) and Technology Acceptance Model (TAM). Rather than focusing solely on continuance intentions to use SNA, our study also examined the willingness of users to provide positive word of mouth about the SNA usage. The confirmatory factor analysis was employment to examine the reliability and validity of the measurement model. The model was tested by Partial Least Squares (PLS) technique. Implications for scholars and practitioners are discussed.

LITERATURE REVIEW

Expectancy Confirmation Model (ECM) is widely used to evaluate consumers' satisfaction and usage behavior in the study of consumer behavior (Tse & Wilton, 1988; Anderson & Sullivan, 1993; Patterson, Johnson, & Spreng, 1997; Bhattacherjee, 2008). ECM proposes that consumers' expectation and perceived performance determine their satisfaction (Oliver 1980, Oliver 1993). Bhattacherjee incorporates perceived usefulness from TAM with ECM to reflect users' expectation (Bhattacherjee, 2001a; Bhattacherjee, 2001b; Bhattacherjee and Premkumar, 2004). There are two internal dimensions of TAM: perceived usefulness (PU) and perceived ease of use (PEOU) (Davis et al., 1989). ECM posits two main determinants of usage behavior (satisfaction and usage intention), and two direct determinants of satisfaction (perceived usefulness and confirmation).

In the revised ECM model, user satisfaction was affected by confirmation and perceived usefulness, continuance intention was determined by satisfaction. In addition, perceived usefulness was affected by confirmation, which has a direct effect on continuance intention.

In previous studies have indicated that users' satisfaction on using specific application targets was influenced by perceived usefulness, confirmation (Sweeney and Soutar, 2001; Kang et al., 2009; Lii and Sy, 2009) and also satisfaction plays an important role in predicting user intention and word of mouth (Bhattacherjee, 2001a, Bhattacherjee et al., 2008, Kim et al., 2009).

Social Network App (SNA) as a social communicate tool belong to a specific application that calls for additional constructs, such as PEOU to be incorporated in order to fit nicely into the ECM domain. The modified ECM model enables a better explanation of SNA usage behavior.

According to ECM, continuance intention is defined as user's continuance intention to a product or service in the post- acceptance stage. The higher perceived satisfaction leads to the higher change to reuse the product or service in the future.

In this study, we defined PU as "the degree to which a person believes that using specific application system would enhance his or her specific performance" (Davis et al., 1989), PEOU as "the degree to which the prospective user expects in using specific application system to be free of effort" (Davis et al., 1989), confirmation as "users' perception of the congruence between expectation of specific application system use and its actual performance" (Bhattacherjee, 2001b).
As above, we proposed the following hypothesis:
H1: Perceived ease of use positively influences perceived usefulness.
H2: Perceived ease of use positively influences user satisfaction.
H3: Confirmation has a significant effect on perceived usefulness.
H4: Perceived usefulness has a significant effect on user satisfaction.
H5: Confirmation significantly influences user satisfaction.
H6: Perceived usefulness positively influences continuance intention.
H7: Satisfaction positively influences continuance intention.
H8: Satisfaction has a significant effect on word of mouth communication.

RESEARCH METHOD

The research model (as shown in Fig.1) is an extension of ECM with TAM. The data used to test the research model were obtained through an online survey of the users of Social Network App (SNA) service.

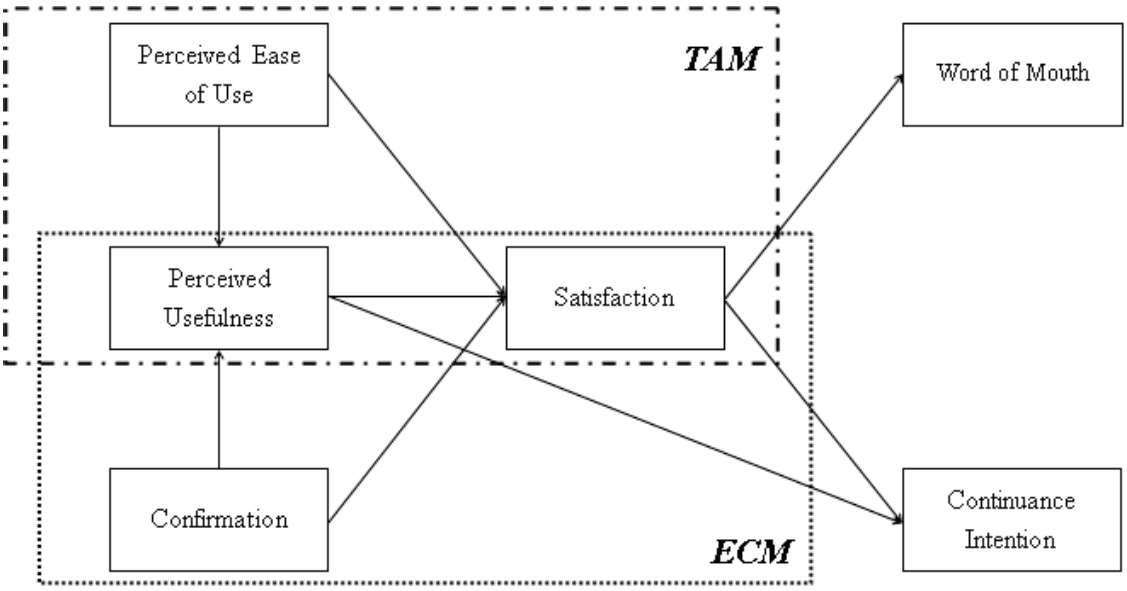


Figure 1 Research Model

METHODOLOGY

1. Measures

The constructs in this study included perceived ease of use, perceived usefulness, confirmation, users' satisfaction, word of mouth and continuance intention. We used established measures from previous literature. The five-point Likert scale, ranging from strongly disagree (1) to strongly disagree (5), was used to measure multi-item perceptual scales.

2. Data collection

We developed our self-administered questionnaire on specific platform for data collection. The existing scales from prior research were used, but modified the wording of the questionnaire in order to fit the particular context of Social Network App usage. In a pretest phase, we invited a small group of IS faculty and doctoral students to review of the survey to modify the scales and questions. The purpose of these pretests was to confirm that relevant aspects were included and to enhance the valid, reliable, and appropriate of the questionnaire. The final questionnaire of 32 items measuring 6 latent variables is presented in Appendix A.
We conducted an online survey about SNA services users' psychological factors in continuance intention. We posted the invitation messages with the URL to the online questionnaire on a number of Facebook groups and technology forums related to App experiencers.

DATA ANALYSIS AND RESULTS

The SmartPLS method was used to perform the statistical analysis in this study.

The PLS procedure (Wold, 1985) is widely adopted by IS researchers in recent years because of its ability to provides a better explanation for medium sample sizes and complex relationships. (Chin 1998).

A two-step analytical procedure (Hair et al. 1998) was used, we first examined the measurement model and then the structural model was used to conduct a path analysis and test our hypotheses. Following the two-step analytic approach, we ensure our conclusion on structural relationship was drawn from a set of measurement instruments with desirable psychometric properties.

1. Descriptive statistics

The survey data was collected in July 2012 to August 2012 to collect data for testing our hypotheses. The respondents were asked to complete the questionnaire based on their experience with Social Network App (SNA) services. The 204 responses were received in this study. The results show that 60% of the respondents were men, 26% between 41 and 55 years old, 59% held a university undergraduate degree, and had 1-2 years of experience in using Social Network App (SNA).

2. Measurement model

Convergent validity and discriminant validity of the constructs indicate the extent to which the items of a scale that are theoretically related should be related in reality. Table 1 present information concerning the estimate of reliability, the composite reliability (CR) ranged from 0.94 to 0.97 are above 0.7, which are higher than the threshold level of 0.7 suggested by Chin (1998). The Cronbach's Alpha, ranged from 0.92 to 0.97, are higher than the threshold level of 0.7 (Nunnally, 1978). The average variance extracted (AVE) ranged from 0.76 to 0.87 in our study, which are higher than the threshold level of 0.50 suggested by Fornell and Larcker (1981) suggested. The validity can be assessed by the square root of the average variance extracted (AVE) for each construct and all data were higher than the corresponding inter-construct correlations as show in Table 2. And the item loadings are greater than 0.707 (Chin, 1998). Overall, we concluded that the measures were valid.

Table 1 Construct reliability measures

Construct	Mean	Standard Deviation	Cronbach Alpha	Composite Reliability	AVE
PEU	3.89706	0.82134	0.93700	0.95052	0.76273
PU	3.79510	0.89057	0.92007	0.94003	0.75833
Con	3.53137	0.82407	0.92537	0.94368	0.77040
SA	3.45980	0.87004	0.94720	0.95951	0.82581
WOM	3.48529	0.93918	0.96659	0.97217	0.83308
CI	3.83333	0.89397	0.94926	0.96335	0.86795

Table 2 Inter-construct correlations and square roots of AVE of low-order constructs.

	PEU	**PU**	**Con**	**SA**	**WOM**	**CI**
PEU	**0.87335**					
PU	0.50677	**0.87082**				
Con	0.48886	0.69181	**0.87772**			
SA	0.48253	0.65781	0.60216	**0.90874**		
WOM	0.46208	0.63270	0.59101	0.81406	**0.91273**	
CI	0.58639	0.62139	0.61997	0.66171	0.71686	**0.93164**

3. Structural model

The path coefficients were yielded by PLS analysis for the structural model. The bootstrap resampling procedure was used to the testing of significance of all paths. Fig. 2 shows the results of the hypothesized structural model test. Table 3 presents the results with overall explanatory powers, estimated path coefficients, and associated t-value of the paths. The overall explanatory power of our research model had R^2 = 49.9%, 66.3%, 49.1% and 51.6% for continued intention, word of mouth, satisfaction and perceived usefulness, revealed that usage of SNA can be predicted by extended ECM with TAM.

As indicated in Table 3, the perceived ease of use and confirmation to perceived usefulness was significant with path coefficients of 0.222 and 0.584 respectively, thus hypotheses H1 and H3 were supported. The effects of perceived ease of use, perceived usefulness, and confirmation were positive relationship to satisfaction with standardized path coefficients of 0.156, 0.412, and 0.241. Hypotheses H2, H4, and H5 were thus supported. The effects of satisfaction were positive relationship to word of mouth with standardized path coefficients of 0.814. Thus, hypotheses H8 was supported. Finally, perceived usefulness and satisfaction had a direct positive relationship to continuance intention with standardized path coefficients of 0.328 and 0.446, respectively. This provided support for hypotheses H6 and H7.

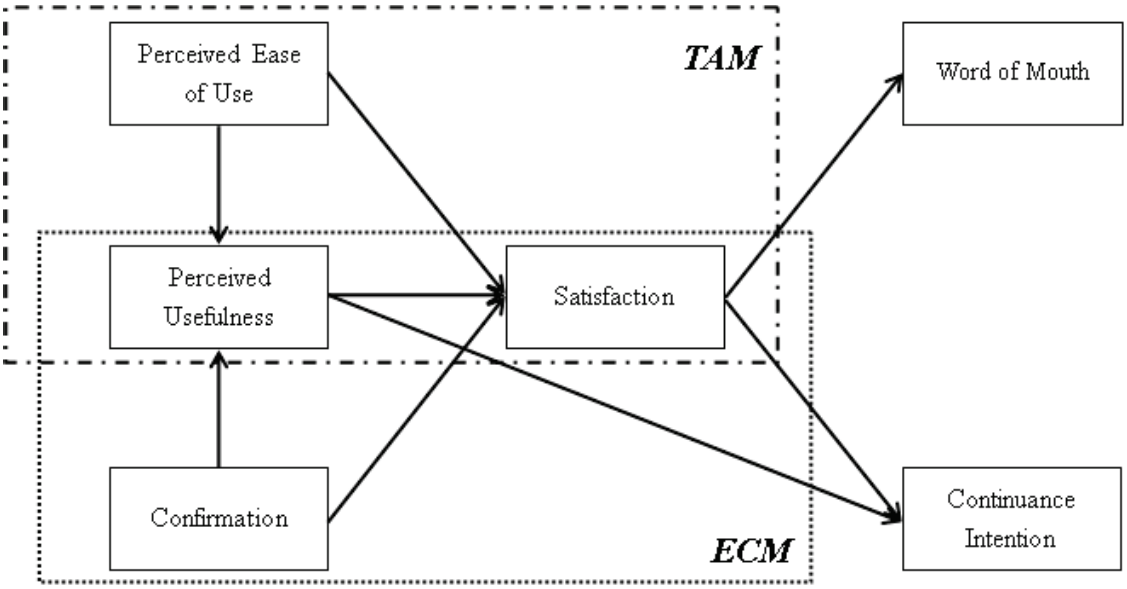


Figure 2 PLS analysis structural model

Table 3 Structure model

Construct	R^2	β	t-value
PEU→PU		0.222***	3.694
CON→PU		0.584***	10.578
PU→SA		0.412***	4.854
PEU→SA		0.156*	2.243
CON→SA		0.241**	2.889
SA→WOM		0.814***	27.951
PU→CI		0.328***	4.089
SA→CI		0.446***	5.135
PU	0.516		
SA	0.491		
WOM	0.663		
CI	0.499		

DISCUSSION AND CONCLUSIONS

This study tries to extend the Oliver's ECM (1980) with Davis's TAM (1989) as the structure model. The path coefficients, including perceived ease of use to perceived usefulness, confirmation to perceived usefulness, perceived usefulness to satisfaction, perceived ease of used to satisfaction, confirmation to satisfaction, satisfaction to word of mouth, perceived usefulness to continuance intention, and satisfaction to continuance intention, are found statistically significant. These results have several implications for academic and practice.

1. Implications for academics

Our study provided an insight into factors contributing to word of mouth and continuance intention to the SNA usage. It also showed that perceived usefulness and satisfaction were the two key factors in determining a customer's continuance intention to the SNA usage. The empirical results show that the unified model supports for all of our hypotheses and has good explanatory power, implying that the integration of ECM and TAM provides a model with a theoretical basis to explain SNA usage.

2. Implications for practitioners

Users' continuance intention was significantly influenced by perceived usefulness and satisfaction (β=0.328, $p<0.001$; 0.446, $p<0.001$), which was accordant to our hypothesis. Especially, the result shows that satisfaction is the strongest predictor of users' continuance intention. It means that if users feel good on the whole to use Social Network App, the users would like to continue the use Social Network App.

However, the perceived usefulness was influenced by confirmation. It demonstrated that people would make sure that the SNA can enhance their effectiveness for life or work before used. Therefore, the confirmation plays the important role on SNA usage. Word of mouth was significantly influenced Satisfaction (β=0.814, $p<0.001$). If people feel satisfy by using SNA, he/her might be more likely to recommend or share the using experience to others. Thus, the developer should concerned that the users' evaluation because word of mouth is important in using SNA service.

SNA users' satisfaction was predicted primarily by users' SNA perceived usefulness and confirmation on a prolonged basis (β=0.412, 0.241, $p<0.001$). However, we found some interesting patterns emerge. If the SNA is benefit to the users or the SNA can enhances users living or working effectiveness, the users will feel satisfy for SNA usage. Additionally, if the user gets the benefit or help to perform many things more conveniently by using SNA, the user will feel more satisfy on it.

LIMITATIONS

It may have some limitations on this study. First, our study examined only on the effect of perceived usefulness and satisfaction to the word of mouth and continuance intention of SNA users. However, other relational constructs may affect the related

continuance intention and word of mouth. Second, the web-based forms was conducted by employed a nonrandom convenience sampling. Gathering a larger using sample an alternate survey modality and random sampling methods would be costly. The online survey method was appropriate for collecting data from participants with Internet experience and who were free of geographical constraints. Third, the findings were acquired from a single study that was targeted to a specific user group, SNA users. Finally, the sample may have been biased for the voluntarily respondents.

REFERENCE

1. E.W. Anderson, M.W. Sullivan, The antecedents and consequences of customer satisfaction for firms, Marketing Science, 12 (2), 1993, pp.125-143.
2. A. Bhattacherjee, Understanding information systems continuance. An expectation-confirmation model, MIS Quarterly, 25 (3), 2001a, pp.351-370.
3. A. Bhattacherjee, An empirical analysis of the antecedents of electronic commerce service continuance, Decision Support Systems, 32 (2), 2001b, pp.201-214.
4. A. Bhattacherjee, J. Perols, C. Sanford, Information technology continuance: a theoretic extension and empirical test, Journal of Computer Information Systems, 49 (1), 2008, pp.17-26.
5. A. Bhattacherjee, G. Premkumar, Understanding changes in belief and attitude toward information technology usage: a theoretical model and longitudinal test, MIS Quarterly, 28 (2), 2004, pp.229-254.
6. W.W. Chin, The partial least squares approach to structural equation modeling," in Modern methods for business research, George A. Marcoulides, Ed. Mahwah, NJ: Lawrence Erlbaum., 1998, pp.189-217.
7. F.D. Davis, Perceived usefulness, perceived ease of use, and user acceptance of information technology, MIS Quarterly, 13 (3), 1989, pp.319-340.
8. F.D. Davis, R.P. Bagozzi, P.R. Warshaw, User acceptance of computer technology: a comparison of two theoretical models, Management Science, 35 (8), 1989, pp.982-1003.
9. C. Fornell, D.F. Larcker., Evaluating structural equation models with unobservable, Journal of Marketing Research, 18 (1), 1981, pp.39-50.
10. J.F. Hair, R.E. Anderson, R.L. Tatham, and W.C. Black, “Multivariate data analysis”, (5 ed.) Englewood Cliffs, 1998, NJ: Prentice-Hall.
11. Y.S. Kang, S. Hong, H. Lee, Exploring continued online service usage behavior: The roles of self-image congruity and regret, Computers in Human Behavior, 25 (1), 2009, pp.111-122.
12. S.S. Kim, J.-Y. Son, Out of dedication or constraint? A dual model of post-adoption phenomena and its empirical test in the context of online services, MIS Quarterly, 33 (1), 2009, pp.49-70.
13. Y.-S. Lii, E. Sy, Internet differential pricing: Effects on consumer price perception, emotions, and behavioral responses, Computers in Human Behavior, 25 (3), 2009, pp.770-777.
14. C. Newark-French, Mobile Apps Put the Web in Their Rear-view Mirror, Retrieved September 26, 2012, from Flurry Blog: http://blog.flurry.com/bid/63907
15. C. Newark-French, Mobile App Usage Further Dominates Web, Spurred by

Facebook, Retrieved September 26, 2012, from Flurry Blog: http://blog.flurry.com/bid/80241
16. J. C. Nunnally, Psychometric theory, 1978, New York: McGraw-Hill.
17. R.L. Oliver, A cognitive model of the antecedents and consequences of satisfaction decisions, Journal of Marketing Research, 17 (4), 1980, pp.460-469.
18. 79. R.L. Oliver, Cognitive, affective, and attribute bases of the satisfaction response, Journal of Consumer Research, 20 (3), 1993, pp.418-430.
19. P. G. Patterson, L. W. Johnson, R. A. Spreng, Modeling the determinants of customer satisfaction for business-to-business professional services. Journal of the Academy of Marketing Science, 25(1), 1997, pp.4-17.
20. J.C. Sweeney, G.N. Soutar, Consumer Perceived Value: The Development of a Multiple Item Scale, Journal of Retailing, 77 (2), 2001, pp.203-220.
21. D. K. Tse, P. C.Wilton, Models of consumer satisfaction: An extension. Journal of Marketing Research, 25, 1988, pp.204–212.
22. H. Wold, Partial least squares, in “Encyclopedia of Statistical Sciences”, S.K.N.L. Johnson (ed.), 1985, Wiley, New York.

Appendix A. Questionnaire items used in this study

Constructs	Questionnaire items
Perceived usefulness	By using Social Network App can provide me with useful information about my work or life. Using Social Network App enhances my effectiveness my working and living effectiveness. Using Social Network App helps me perform many things more conveniently. Social Network App is of benefit to me. Overall, this Social Network App is useful.
Perceived ease of use	Learning to operate the Social Network App is easy for me. I have no problem in using Social Network App. I find the Social Network App to be easy to use. It is easy for me to become skillful at using the Social Network App. Interaction with the Social Network App does not require a lot of my mental effort. Overall, this Social Network App is easy to use.
Confirmation	My expectation with using Social Network App was satisfied as a whole. The benefit provided by Social Network App was better than what I expected. The service content delivered by Social Network App was more thoughtful than what I expected. The service level provided by Social Network App was better than I expected. Overall, the service of Social Network App mostly met my expectation.
Satisfaction	My decision to use Social Network App was a wise one. I am satisfied with using Social Network App. I feel extremely satisfied about my overall experience of using Social Network App. I think, I did the right thing by deciding to use Social Network App. It was good on the whole to use Social Network App.
Word of mouth	I will encourage friends and relatives to use Social Network App. I will recommend using Social Network App to others who seek my advice. I tell people positive things about Social Network App. I will urge my friends to use Social Network App. I will advise other people to use Social Network App. I don't hesitate to say good things about using Social Network App. I would like to share my using Social Network App experience.
Continuance Intention	In the future, I expect I will continue to use Social Network App. I prefer to continue to use Social Network App for process modeling over other process modeling grammars. If I could, I would like to continue the use Social Network App. I will frequently using Social Network App in the future

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

TRAINING, CREATIVITY AND INNOVATION

Valerij Dermol, International School for Social and Business Studies, Slovenia
valerij.dermol@mfdps.si

Nada Trunk Širca, International School for Social and Business Studies, Slovenia
trunk.nada@gmail.com

ABSTRACT

Purpose: *The purpose of the research is to examine the effect of a combination of training and training transfer factors on intentions to create new knowledge through stimulating creativity, experimentation and introduction of new products, services and processes in companies.*
Design/methodology/approach: *In the study we use quantitative research methods, based on data collected on a sample of 247 Slovenian service companies. To process the data, various multivariate statistical methods were used (factor analysis and multivariate regression analysis).*
Findings: *In the study we find positive effects of adequate quantity and quality of training and the training transfer factors on intentions to create new knowledge in an organisation. Among the training transfer factors the study reveals a relatively strong influence of organisational incentives (related to peer and especially supervisor support. The effect of training is positive and relatively strong.*
Research limitations/implications: *The study represents a starting point for exploring the relationship between training and processes of creation of new knowledge. To improve the reliability of the study, additional research should be undertaken using mixed research methods.*
Practical implications: *The study presents useful findings about the potentialities for encouraging creativity, experimenting and creating new knowledge required for further companies' development.*
Originality/value: *In the areas of research focused on training and training transfer factors there is not much work done related to the study of relationships between training and creativity, innovation and development of new products, services or processes. Most research has been focused on the questions how to promote learning, cognitive and behavioural changes, knowledge transfer and organisational performance. Therefore, we believe, that this study represents an original contribution to the promotion of training in an organisation as a means of enhancing creativity, innovation and new knowledge development.*

Keywords: Training, training transfer factors, knowledge creation

INTRODUCTION

In the literature there are quite some studies which investigate relationships between training, training transfer factors and different aspects of organisational performance. For example, research links training and training related factors to lower costs, reduced scrap, increased labour productivity (Cutcher-Gershenfeld, 1991; Bartel, 1994; Huselid, 1995), increased financial performance, sales, market share and profits (Russell *et al.,* 1985; Lane *et al.,* 2001;

Lyles and Salk, 2007), quality of products, reduced absenteeism and staff turnover, etc.(Guzzo *et al.,* 1985; Huselid, 1995; Katz *et al.,* 1983). The weak point of many of these studies is their focus on specific industries, allowing only a limited generalization of findings. In our previous study (Dermol and Čater, 2013) we confirmed positive links between training, peer support, supervisor support and organisational incentives and organisational performance mediated by organisational learning processes.

On the other hand, there are not so many studies relating training with knowledge transfer (Gupta and Govindarajan, 1991; Szulanski, 1996; Gupta and Govindarajan, 2000; Minbaeva *et al.,* 2003; Lyles and Salk, 2007), or creativity and innovation capabilities (Gupta and Singhal, 1993; Laursen and Foss, 2003; Minbaeva 2005). Abilities of creativity, innovation, new knowledge development and introduction of new products and services are crucial for success in modern world.

In the study presented in this paper we investigate the links between quality and volume of training, training transfer factors such as peer support, supervisor support and organisational incentives on one side and the existence of processes, related to creativity, innovation and new knowledge creation in an organisation on the other. In the first part of the paper we describe the constructs and indicate links between them, in the second part of the paper we present the research methodology and key findings of the analysis.

LEARNING CONSTRUCTS

1. Quality and volume of the training

Training is defined as the systematic development of skills that individuals need to perform certain work (Miglič, 2002). Individuals should take their own responsibility for their professional development but realise their learning needs in partnership with their colleagues at work and their direct superiors using different learning methods (Torrington *et al.,* 2008). Armstrong (2003) and Torrington *et al.* (2008) identify a range of different approaches to training. They state that the training may be based on different methods of teaching – both off-job methods (formal education, consultancy courses, outdoor-type courses, in-house courses, dramas and improvisations, role-plays, simulations etc.) as well as on-the-job learning methods (instructions, mentoring, self-development, self-development teams, the use of learning logs and learning contracts, e-learning, blended learning etc.).

Dechawatanapaisal and Siengthai (2006) consider that adequate opportunities for training should be offered to the employees. Garvin *et al.* (2008) say as well that all the employees in an organisation should receive periodic training. In particular, they highlight the importance of training for new employees and training in cases of special events in the organisation and emphasise the need to train employees when new business or work initiatives emerge, as well as in cases of employees' transfer to other posts or changes to the content of existing jobs. Jarvis *et al.* (2006) consider that in the past was mostly the upper levels of organizational hierarchies benefited from the training, but the situation in the last 50 years has changed. Blandy *et al.* (2000), for example, reported that the majority of organisations train 80-85% of their employees.

The quality training might be defined as customer focused, with high quality of service, controlling the process quality and with evaluation of quality (Burgarelly *et al*., 2002). The CEDEFOP (1996) notes that the quality of training reflects the quality of service, user satisfaction, quality of processes, the achievement of quality standards as well as the proper relationship between quality and price. Seyfried (1998) associates training quality with the implementation of quality objectives and with meeting standards when performing learning processes. Council of Europe (2005) emphasises that the training should address useful contents that could be used in practice. In addition to technical knowledge and technical skills training should provide some emotional skills needed to perform specific type of work as well. The quality of orientation training for new employees is determined by a clear set of learning objectives, appropriate teaching methods, integration of practical experience, relevance of learning tools, professionalism of trainers and the existence of training evaluation.

2. Supervisor support

Support provided by employees' supervisors significantly and positively affects transfer of training to a specific work context. Campbell (1969), for instance, emphasises the importance of adequate leadership styles. Bader and Bloom (1995), from practical perspectives, emphasise the need for supervisors' active participation in the processes of planning and preparation of the training. Some other authors Wieland Handy (2008) note that supervisors should promote the training transfer by explaining their employees the expectations about after-training behaviour and performance, helping them to identify opportunities to implement the newly acquired knowledge and providing information that might be helpful to their employees. Furthermore, any help offered by supervisors seems to be of a crucial importance when employees encounter problems while using the acquired knowledge.

3. Peer support

Support provided by the peers, co-workers or colleagues at work is another significant factor influencing the training transfer. It is reflected mainly through joint identification and implementation of learning opportunities and application of the acquired knowledge. Wieland Handy (2008) emphasises the need for appropriate norms within the group which involve the whole group in the learning process. Peers should play an important role in explaining and promoting learning in an organisation being patient while their colleagues are trying to implement the newly acquired knowledge in the workplace and providing the colleagues with the assistance when they need one. They have the power to promote and also to prevent the transfer of training (Holton III *et al.,* 2003).

4. Organisational incentives

Holton III *et al.* (2003) acknowledge the existence of certain organisational mechanisms which enable organisations to promote training transfer. These mechanisms comply with the factors acknowledged by Herzberg's motivation theory (Lipičnik and Možina, 1993). Among these mechanisms there are certain factors which create conditions for training transfer or/and eliminate eventual inconveniences and obstacles. On the other hand there are some factors which promote training transfer as well.

Among factors which eliminate possible inconveniences and create conditions for the training transfer some of them are related to work conditions, others to control mechanisms or mechanisms which enable feedback of information regarding performance and training transfer. Garvin *et al.* (2008) for instance emphasise the importance of adequate financial support after the training and also providing material, equipment and information which is needed for successful training transfer.
If employees on the other hand perceive training as an opportunity to increase their efficiency and personal satisfaction and align training with possibilities to gain more respect among colleagues, higher salary or other benefits, promotions and opportunity to climb up the career leader, the probability of successful training transfer is even higher. This is particularly true if organisations provide them with adequate resources and budget available (Wieland Handy, 2008).

KNOWLEDGE CREATION THROUGH CREATIVITY AND INNOVATION

The extent of creativity and experimentation leading to introduction of new products, services and processes in an organisation is positively affected by the existence of an environment which encourages learning. For example, Martins and Terblanche (2003) note that successful »organisations and leaders try to create an institutional framework in which creativity and innovation will be accepted as basic cultural norms in the midst of technological and other change«. Learning culture and appropriate managerial practices may be significant factors contributing to the extent creativity and innovations appear in an organisation (Judge *et al.,* 1997) since such culture »refers to basic assumptions [...] maintained in the continuous process of human interaction« (Martins and Terblanche, 2003) and are prescriptions for ways to perform in an organization. Martins and Terblanche (2003) recognise five crucial factors, which stimulate innovation and creativity in an organisation: strategy, structure, support mechanisms, behaviour and communication. Easterby-Smith (1990) defines experimenting organisations which generate creativity and innovation in people through the introduction of flexibility in organisational structures. Such organisations focus on unusual variations in information systems and encourage individuals to take risks (Jashapara, 2011). Kenny and Reefy (2006) recognise relationship between several cultural elements, organisation's commitment to R&D and its performance. Besides adequate resources and adequate funding, they emphasise the importance of some elements related to learning culture such as non-constraining environment, supportive management, technically competent team and appropriate strategic direction. In their research, they find a significant correlation between organisation's commitment to R&D and the number of new products and services launched. More specifically, Garvin *et al.* (2008) stress the importance of three building blocks of learning culture – supportive learning environment, leadership that reinforces learning and concrete learning processes and practices including experimentation and knowledge creation.
On the basis of described theoretical background and our believes that learning induced through learning and existence of learning transfer factors positively affects new knowledge creation in an organisation we set the following hypothesis:
Combination of training, peer support, supervisor support and organisational incentives positively influence creativity, innovation and knowledge creation in an organisation.

METHODOLOGY AND ANALYSIS

During June and July 2009 the research was carried out to measure the influences of training and training transfer factors on creation of new knowledge and introduction of new products, services and processes through stimulating creativity, experimentation and innovation. Questionnaires were sent to 1819 service organisations in Slovenia (548 large, 703 medium-sized and 568 small) located in Slovenia. We received 247 completed questionnaires (19 % from large organisations, 39 % from medium-sized and 39 % from small ones). The responsiveness was 13.6 %.

The questionnaire was developed as a combination of measurement scales found in respective literature as indicated in Table 1.

Table 1: Measurement scales (examples, number of items, authors)

Knowledge creation (KNCR) (e.g. we experiment frequently with new ways of working; we practice brainstorming retreats or camps)	4	Garvin *et al*, 2008
	2	Wang *et al.* (2007)
Volume and quality of training (TRAING) (e.g. training is of high quality, training is constantly revised and upgraded to fit the changing environment, experienced employees receive periodic training and training updates, experienced employees receive training when new initiatives are launched)	4	Dechawatanapaisal and Siengthai (2006)
	1	Vlachos (2008)
	4	Garvin *et al.* (2008)
	2	Young-Chan and Sun-Kyu (2007)
Supervisor support (SPRVSR) (e.g. supervisors show interest in what employees learn in training, supervisors meet with employees to discuss ways to apply their training to the job, supervisors meet with employees to work on problems they may have in trying to use their training)	1	Vlachos (2008) Garvin *et al.* (2008) Young-Chan and Sun-Kyu (2007)
Peer support (PEER) (e.g. employees appreciate colleagues using new skills they have learned in training, employees encourage their colleagues to use the skills they have learned in training, employees expect colleagues to use what they learn in training at work.	4	
Organisational incentives (INCENT) (e.g. when employees try new things they have learned, they know who is going to help them, when employees in this organisation do not use their training it gets noticed, after training employees get feedback from people on how well they are applying what they have learned)	2	

In the statistical analysis we follow the procedure suggested by, for example, Sakar *et al.* (2011). The relationship between the independent and dependent variables were examined by conducting exploratory factor analysis and multiple linear regression analyses. Firstly, factor analysis was implemented to calculate factor scores which were then entered into the multiple linear regression analysis as independent variables. Besides, the approach suggested by

Huselid (1995) and Minbaeva (2005) was used as well. This way we tried to recognise possible complementarities between the independent variables, i.e. possible synergetic effects of combinations of training and training transfer factors on creativity, innovation and new knowledge creation in an organisation.

As it can be seen in the Table 2, all the dependent variables positively influence creation of new knowledge in an organisation. The strongest effect seems to come from organisational incentives and from delivering trainings in an organisation. Peer support seems to have medium sized and positive effect on new knowledge creation, on the other hand, the influence of supervisor support seems to be relatively weak, nevertheless, statistically significant.

To test complementarities Huselid (1995) and Minbaeva (2005) suggest using multiplicative approach and testing a full set of interactions while controlling for main effect of individual independent variables. The analysis (see Table 2, model 2) indicates that complementarity exists between supervisor support and organisational incentives, but the interaction between these two variables is negative, meaning that the simultaneous operation of these two factors adversely affects the creation of new knowledge.

Table 2: Regression analysis

Model		Beta	Std. Error
1	(Constant)	4.122***	0.062
	TRAING	0.385***	0.067
	PEER	0.255***	0.067
	INCENT	0.407***	0.069
	SPRVSR	0.153**	0.070
	F value	52.52***	
	R-square	0.465	
	Adjusted R-square	0.456	
2	(Constant)	4.129***	0.062
	TRAING	0.414***	0.073
	PEER	0.271***	0.071
	INCENT	0.395***	0.070
	SPRVSR	0.136**	0.074
	TRAING x SPRVSR	0.014	0.068
	TRAING x INCENT	-0.027	0.076
	TRAING x PEER	0.074	0.066
	SPRVSR x INCENT	-0.105*	0.076
	SPRVSR x PEER	-0.023	0.074
	INCENT x PEER	0.076	0.055
	F value	22.19***	
	R-square	0.485	
	Adjusted R-square	0.463	

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

CONCLUSIONS

The study highlights the importance of training and introduction of systematic organisational incentives for encouraging creation of new knowledge through creativity in experimentation. Peer support and especially supervisor support are not as important factors as one might think but nevertheless they have a positive effect on knowledge creation. In an organisation managers should therefore in the first place encourage systematic training and also take care of conditions for training and training transfer, especially by promoting training transfer processes and eliminating potential inconveniences and obstacles for learning.

The findings of the study are somehow in line with the findings in literature related to social networking issues which link network density and strong ties characterised by frequent communication and emotional closeness with effective inter-firm cooperation but not with knowledge creating and innovation capability. It seems that only the existence of network heterogeneity and weak ties between individuals across social units are predecessor of knowledge creating or innovation capability in an organisation (Swart, 2006). This might be the reason for rather weak relationship between creation of knowledge on one side and peer support and supervisor support on the other, as the data showed in our study. The training seems to be an opportunity to establish weak ties with external sources of knowledge, and to increase the heterogeneity of the organisation's social network. Besides, the study shows that simultaneous implementation of organisational incentives in the sense of provision of material, equipment, information, financial support and feedback needed for a successful transfer of training into the work context, and supervisor support in the sense of explanation of expectations about post-training behaviour, joint identification of learning opportunities, and provision of information that is helpful to employees, adversely affects the creation of new knowledge. This is another issue which the managers should be aware of. Too much of formalisation in this sense harm the processes of knowledge creation.

The study represents the starting point for investigation the relationships between training, training transfer factors, creativity and innovation. It is based on a sample of 247 Slovenian services companies and on qualitative research approach. We believe that the study might be improved especially in two ways – through bigger sample which would enable cross validation of the model and through the use of complementary qualitative and quantitative research methods.

LITERATURE

1. Armstrong, M. (2003), *A Handbook of Human Resource Management Practice*, Kogan Page Ltd., London.
2. Bader, G.E. and Bloom, A.E. (1995), *Make Your Training Results Lasts*, Kogan Page Ltd., London.
3. Bartel, A.P. (1994), »Productivity Gains from the Implementation of Employee Training Programs«, *Industrial Relations*, Vol. 33 No. 4, pp. 411–425.
4. Blandy, R., Dockery, M., Hawke, A., and Webster, E. (2000), *Does training pay?*, National Centre for Vocational Education Research, Leabrook, South Australia.
5. Campbell, D.T. (1969), »Reforms as Experiments«. *American Psychologist*, No. 24, pp. 409–429.

6. CEDEFOP (1996), Evaluation of European Training, Employment and Human Resource Programmes.
7. Council of Europe (2005), »Conclusions of the 7th plenary meeting of the European network for the exchange of information between persons and entities responsible for the training of judges and public prosecutors«. Available at: http://www.coe.int/t/dghl/cooperation/lisbonnetwork/meetings/Plenary/2005Strasbourg_en.pdf.
8. Cutcher-Gershenfeld, J. (1991), »The impact on economic performance of a transformation in industrial relations«, *Industrial and Labor Relations Review*, Vol. 44 No. 2, pp. 241 – 260.
9. Dechawatanapaisal, D. and Siengthai, S. (2006), »The impact of cognitive dissonance on learning work behavior«, *Journal of Workplace Learning*, Vol. 18 No. 1, pp. 42–54.
10. Dermol, V. and Čater, T. (2013), »The influence of training and training transfer factors on organisational learning and performance«, *Personnel Review*, Vol. 42 No. 3, pp. 324–348.
11. Easterby-Smith, M. (1990), »Creating a learning organisation«. *Personnel Review*, Vol. 19 No. 5, pp. 24–28.
12. Garvin, D.A., Edmondson, A.C., and Gino, F. (2008), »Is Yours a Learning Organization?«, *Harvard Business Review*, Vol. 51 No. 2, pp. 109–116.
13. Gupta, A. and Singhal, A. (1993), »Managing human resources for innovation and creativity«, *Research technology Management*, Vol. 36 No. 3, pp. 41–48.
14. Gupta, A.K. and Govindarajan, V. (1991), »Knowledge Flows and the Structure of Control Within Multinational Corporations«, *Academy of Management, The Academy of Management Review*, Vol. 16 No. 4, pp. 768–792.
15. Gupta, A.K. and Govindarajan, V. (2000), »Knowledge flows within MNCs«, *Strategic Management Journal*, No. 21, pp. 473–496.
16. Guzzo, R.A., Jette, R.D., and Katzell, R.A. (1985), »The Effects of Psychologically Based Intervention Programs on Worker Productivity: A Meta-Analysis«, *Personnel Psychology*, No. 38, pp. 275–291.
17. Holton III, F.E., Hsin-Chih, C., and Naquin, S.S. (2003) »An Examination of Learning Transfer System Characteristics Across Organizational Settings«, *Human Resources Development Quarterly*, Vol. 14 No. 4, pp. 459–482.
18. Huselid, M.A. (1995), »The impact of human resource management practices on turnover, productivity, and corporate financial performance«, *Academy of Management Journal*, Vol. 38 No. 3, pp.635–672.
19. Jarvis, P., Holford, J., and Griffin, C. (2006), *The theory and practice of learning*, RoutlegeFalmer, Oxon.
20. Jashapara, A. (2011), *Knowledge management, An integrated approach*, Pearson Education Limited, Harlow.
21. Judge, W.Q., Fryxell, G.E., and Dooley, R.S. (1997), »The new task of R&D management: Creating goal-directed communities for innovation«, *California Management Review*, Vol. 39 No., pp. 72–85.
22. Katz, H.C., Kochan, T.A., and Gobeille, K.R. (1983) »Industrial Relations Performance, Economic Performance and QWL Programs: An Interplant Analysis«, *Industrial and Labor Relations Review*, Vol 37 No. 1, pp.3–17.
23. Kenny, B. and Reefy, E. (2006), »The Impact of Organisational Culture Factors on Innovation Levels in SMEs: An Empirical Investigation«, *Irish Journal of Management*, Vol. 27 No. 2, pp. 119–142.

24. Lane, P., Salk, J.E., and Lyles, M.A. (2001), »Absorptive capacity, learning, and performance in international joint ventures«, *Strategic Management Journal*, Vol. 22 No. 12, pp.1139–1161.
25. Laursen, K. and Foss, N.J. (2003), »New human resource management practices, complementarities and the impact on innovation performance«, *Cambridge Journal of Economics*, Vol. 27 No. 2, pp. 243–263.
26. Lipičnik, B. and Možina, S. (1993), *Psihologija v podjetjih*, Državna založba d.d., Ljubljana
27. Lyles, M.A. and Salk, J.E. (2007), »Knowledge acquisition from foreign parents in international joint ventures: An empirical examination in the Hungarian context«, *Journal of International Business Studies*, Vol. 38 No. 2, pp.3–18.
28. Martins, E.C. and Terblanche, F. (2003), »Building organisational culture that stimulates creativity and innovation«. *European Journal of Innovation Management*, Vol. 6 No. 1, pp. 64–74.
29. Miglič, G. (2002), *Analiza potreb po usposabljanju* 1. Izdaja., Ministrstvo za notranje zadeve, Ljubljana.
30. Minbaeva, D.B. (2005), »HRM practices and MNC knowledge transfer«. *Personnel Review*, Vol. 34 No. 1, pp.125–144.
31. Minbaeva, D.B., Pedersen, T., and Björkman, I. (2003), »MNC knowledge transfer, subsidiary absorptive capacity, and HRM.« *Journal of International Business Studies*, Vol. 34 No. 3, pp. 586–599.
32. Russell, J.S., Terborg, J.R., and Powers, M.L. (1985), »Organizational Performance and Organizational Level Training and Support«, *Personnel Psychology*, No. 38, pp.849–863.
33. Sakar, E., Keskin, S., and Unver, H. (2011), »Using of factor analysis scores in multiple linear regression model for prediction of kernel weight in Ankara walnuts«, *The Journal of Animal & Plant Sciences*, Vol. 21 No. 2, pp.182–185.
34. Seyfried, E. (1998), *Evaluation of Quality Aspects in Vocational Training programmes* Synthesis report., European Centre for the Development of Vocational Training.
35. Swart, J. (2006), »Intellectual capital: disentangling an enigmatic concept«, *Journal of Intellectual Capital*, Vol. 7 No. 2, pp.136–159.
36. Szulanski, G. (1996), »Exploring internal stickiness: Impediments to the transfer of best practice within the firm«. *Strategic Management Journal*, No. 17, pp.27–43.
37. Torrington, D., Hall, L., and Taylor, S. (2008), *Human Resource Management*, Pearson Education Limited, Harlow.
38. Vlachos, I., 2008. »The effect of human resource practices on organizational performance: evidence from Greece«. *The International Journal of Human Resource Management*, Vol. 19 No. 1, str.74–97.
39. Wang, E., Klein, G., and Jiang, J.J. (2007), »IT support in manufacturing firms for a knowledge management dynamic capability link to performance«, *International Journal of Production Research*, Vol. 45 No. 11, pp.2419–2434.
40. Wieland Handy, L.A. (2008), *The Importance of the Work Environment Variables on the Transfer of Training* Doctoral dissertation., University North Carolina.
41. Young-Chan, L. and Sun-Kyu, L. (2007), »Capabilities, Processes, and Performance of Knowledge Management: A Structural Approach«. *Human Factors and Ergonomics in Manufacturing*, Vol. 17 No. 1, pp.21–41.

Authors

Valerij Dermol
International School for Social and Business Studies, Slovenia
valerij.dermol@mfdps.si

Valerij Dermol, Ph.D. is an Assistant Professor at International School for Social and Business Studies in Celje, Slovenia. He has been involved in research and development projects on organisational learning, lifelong learning, entrepreneurship and entrepreneurial learning. For many years he has been also working as a consultant in some international consultancy companies.

Nada Trunk Širca
International School for Social and Business Studies, Slovenia
trunk.nada@gmail.com

Nada Trunk Širca is a professor at University of Primorska and at International School for Social and Business Studies. She has a Ph.D. in Management in Education. Her research and teaching fields include management, quality and evaluations, education and training, higher education, lifelong learning. She has rich management experiences and wide international experiences.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

MARKET DEMAND, GREEN INNOVATION, AND FIRM PERFORMANCE: EVIDENCE FROM HYBRID VEHICLE INDUSTRY

Ru-Jen Lin, Lunghwa, University of Science and Technology, Taiwan
rjlin@mail.lhu.edu.tw

Rong-Huei Chen, Lunghwa, University of Science and Technology, Taiwan
ronghuei@mail.lhu.edu.tw

Thao-Minh Ho, Chung Hua, University, Hsinchu, Taiwan
sissi_hai@yahoo.com

ABSTRACT

Purpose: *Despite the stimulating roles of market demand and green issues to green innovation and business success, the relationships among these aspects remains controversial. The lack of the consensus on these links causes a missing research gap in the extant literature. This study aims to examine the mediating effect of green innovation and environmental performance on the relationship between market demand and firm performance in Taiwanese hybrid vehicle industry.*
Design/methodology/approach: *The Taiwanese hybrid vehicle industry was targeted as the main research scope. Using random sampling method, survey questionnaires were distributed to retailers, wholesalers, and component sale firms in the automobile industry through post, e-mails, and fax. The Structural Equation Modeling (SEM) approach was used to test the hypotheses and the theoretical model.*
Findings: *The findings prove the significant impacts between market demand and green innovation as well as environmental performance to firm performance; however, the mediating effects of green innovation and environmental performance remain insufficient.*
Practical implications: *The results strongly suggests firms to make more efforts to understand customer needs and excel their competencies in innovating products and processes in a green manner to better align green innovation initiatives with consumer values to promptly satisfy market demand and achieve more effective competitive advantages.*
Originality/value: *This research is the first of its kind to establish the theoretical model for investigating the links among market demand, green innovation, environmental performance, and firm performance in Taiwanese hybrid vehicle industry, which contributes to the understanding of green issues in this competitive industry. As such, the findings helpfully provide effective guidelines for firms in achieving first-mover advantages, market leadership, and sustainable competitiveness.*

Keywords: market demand, green innovation, firm performance, process innovation, product innovation
Paper type: Research paper

INTRODUCTION

Facing currently intense customers' green demands and global environmental concerns, green innovation has been touted as an effective approach for firms to achieve a win-win status of being green and sustainably competitive (Porter and van der Linde, 1995; Pujari, 2006). Nonetheless, a continual debate on what actually composes green products has also been observed (Berchicci and Bodewes, 2005).

Worth noticing, the relationships among firms' green innovation capabilities, market demand, and performances remain controversial. Although green innovation does explicitly address environmental issues, it is far from certain whether green products can truly achieve market success (Pujari, 2006). Additionally, while market demand is suggested to be an important factor inducing green innovation (Wei and Morgan, 2004), Berthon et al. (1999) argue that listening too closely to customer voice may impair innovative sustainable product development capabilities. Simultaneously, whereas some empirical findings confirm the positive relationship between green innovation and firm performance, a major of studies have indicated otherwise (Koellinger, 2008).

Despite numerous studies on the links between green issues and performance or competitive advantage (Chiou et al., 2011), the conflicting findings have considerably illustrated a research gap on the links among market demand, green innovation, and firm performance. Therefore, this study aims to examine the link between market demand and firm performance with green innovation and environmental performance as the mediators in Taiwanese hybrid vehicle industry. As such, based on the database on Taiwan's Top 5000 largest enterprises from Taiwan Ministry of Economic Affairs, survey questionnaires were randomly conducted with retailers, wholesalers, and component sale firms in the automobile industry through mails, e-mails, and fax. By utilizing the Structural Equation Modeling (SEM) approach to test the theoretical model, this study attempts to address the following research questions:
(a) How does market demand affect green innovation and environmental performance?
(b) How can green innovation affect firm performance?

In essence, since sufficient understanding of green issues can beneficially assist firms in establishing successful operational and new product development strategies, this study provides firms with useful references for improving overall performance, gaining first-mover competitive advantages and market leadership. The findings also contribute to the knowledge of green innovation and green demands in Taiwanese hybrid vehicle industry since these issues are currently both challenges and opportunities in this competitive market.

Taiwanese hybrid vehicle industry was chosen to be the research focus for several compelling reasons. First, this important industry is currently making great efforts to apply advanced technologies in product and process development for both environmental protection and industrial advancement (Chou and Hsiao, 2005). Second, under intense pressures from green regulations, customers, and especially tremendous carbon dioxide level from vehicle exhaust, the hybrid vehicle technology in Taiwan has become a promising solution to significantly decrease reliance on oil supplies, fuel consumption, and CO2 emission as well as enhance energy efficiency and firms' green image (Fontaras and Samaras, 2007). Finally, due to several common development patterns with regional developing countries, the achieved experience in Taiwan can usefully shed light on future firm growth in Asia.

The remainder of this research begins with a brief literature review, followed by empirical research method, data analysis, results, and discussions. Finally, the study ends with conclusions, implications, and recommendations for future research.

LITERATURE REVIEW

1. Market demand

In this customer-oriented era, since customer preferences keep changing constantly, firms' capabilities in satisfying market demand refer to the extent firms understand customer needs to better anticipate their preferences and gain competitive advantage (Zhou et al., 2009).

Regarding market demand, customers are the key element driving firms' eco-innovation with the aim of delivering more value-added customer benefits (Kammerer, 2009; Horbach et al., 2012). For instance, along with current green trends, customers are observed to keep modifying their positive behaviors to reduce environmental damage, even are willing to pay higher prices for green and energy-efficient products (Chen, 2008; Chiou et al., 2011). To satisfy these green demands, firms have to innovate products and processes through implementing green technologies, eco-design, and international environmental management systems (Zhu et al., 2008; Hsu and Hu., 2011). Hence, market demand is assumed to be the key factor stimulating green innovation through inducing successful new product performance (Wei and Morgan, 2004; Chiou et al., 2011).

2. Green innovation

Increasing green concerns from public, regulations, and governments worldwide have strongly enforced firms to achieve competitive sustainability through developing new green products and advancing new green manufacturing processes to satisfy stringent green regulations and green demands and overcoming competitors with differentiation strategies (Porter and van der Linde, 1995; Pujari, 2006; Huang and Wu, 2010). Due to environmental concerns in Taiwanese hybrid vehicle industry, this study adopts the ideas of Chen et al. (2006), Chen (2008), Oltra and Saint Jean (2009), and Halila and Rundquist (2011) to define green innovation as the development and implementation of new products and processes which contribute to a sustainable environment through facilitating eco-target achievements and ecological footprint reduction throughout the entire manufacturing processes and product life cycle, which in turns effectively help firms promote productivity, corporate reputation, and image, develop new markets, and achieve first-mover advantages.

2.1 Green product innovation

Chen et al. (2006), Kammerer (2009), and Carrillo-Hermosilla et al. (2010) identify green product innovation to be the introduction of new or significantly improved products for environmental concerns (i.e. raw material use efficiency, green design, energy saving, recycling, waste minimization), being conducted under pressures of shortened product life cycle and increasing competition. With green attributes, green product innovation is perceived to be the cost-effective means for both consumers and producers (Pujari, 2006).

2.2 Green process innovation

Green process innovation is defined as the modifications in manufacturing processes and systems to produce environmentally friendly products which are closely related for eco-targets (e.g. energy saving, pollution prevention, waste recycling, and no toxicity) (Meeus and Edquist, 2006).

3. Environmental performance

Environmental performance is considered the impact of firms' activities on the natural milieu (Klassen and Whybark, 1999). In the context that the global economic growth is currently encountering extreme threats of fossil fuel exhaustibility, energy shortage, and high gas and electricity prices, energy-saving and environmental performance management have become the top-concerned priorities worldwide (Du and Liu, 2011).

4. Firm performance

This study proposes firm performance includes market share (Rex and Baumann, 2007; Li et al., 2010) and reputation (Chen, 2008; Oltra and Saint Jean, 2009) since they are considered the most important competitive factors for manufacturing firms. Interestingly, firms' reputation and environmental endeavors considerably affect customer preferences and purchasing behaviors (Oltra and Saint Jean, 2009).

4.1 Market share

The positive impacts of green innovation on corporate competitive advantages and market share enhancement have been widely confirmed (Chen et al., 2006; Iwu, 2010; Chiou et al., 2011). In support, Rubik et al. (2005) point out the main motivation for firms to conduct green innovation is to promote more transactions. As such, market share is referred to as the useful means for addressing potential aspects of consumer needs and better sales volume (Rex and Baumann, 2007; Chen, 2008).

4.2 Reputation

Reputation is considered an important intangible resource considerably affecting firms' market performance and distinguishing firms in the marketplace (Juma and Payne, 2004). In the extant literature, firm reputation has been perceived as an important basis for customers to evaluate product quality (Chang and Fong, 2010) and helps firms enhance corporate image and market value (Kwansa et al., 2008) as well as gain better customer satisfaction and loyalty and sustainable competitive advantages (Martenson, 2007).

In sum, to address the research questions, this study aims to verify the effects of market demand on firm performance through green innovation and environmental performance. Accordingly, the research framework is established as in Figure 1.

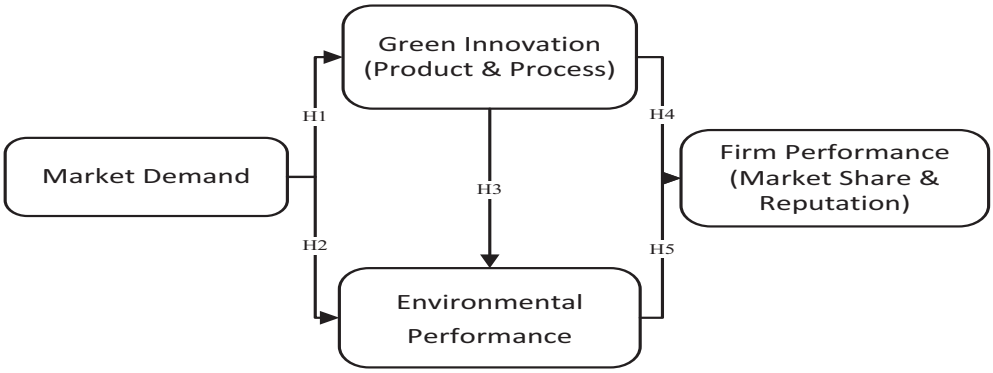


Figure 1. Research Framework

HYPOTHESIS DEVELOPMENT

1. Market demand and Green innovation

In this era, green-conscious customers have expressed more demands for energy-efficient and innovative green products (Chiou et al., 2011), even are willing to pay higher prices (Chen et al., 2008). For effective response, firms must innovate manufacturing processes and products using environmental management (Hsu and Hu., 2011). In other words, innovative product or process development undertaken for environmental reasons is strongly stimulated by market demand (Chiou et al., 2011). Accordingly, the following hypotheses are proposed.

H1-a: Market demand positively affects green product innovation.
H1-b: Market demand positively affects green process innovation.

2. Market demand and Environmental performance

Currently intense green demands have strongly enforced firms to conduct flexible and energy-efficient manufacturing strategies through adopting green management to reduce environmental damage (Chiou et al., 2011; Hsu and Hu., 2011). Since environmental performance is identified to be environmental management output (Klassen and Whybark, 1999), green management practice implementation typically improves firms' environmental performance (Zhu and Sarkis, 2004). Hence, the following hypothesis is suggested.

H2: Market demand positively affects environmental performance.

3. Green innovation and Environmental performance

Meeus and Edquist (2006) argue that firms conduct green innovation to manufacture environmentally-friendly products that can effectively eliminate environmental damage. Hence, since being closely associated with corporate environmental management and eco-target achievements (i.e. raw material use efficiency, energy saving, pollution prevention, waste minimization, reuse, and recycling), green innovation has been widely believed to

stimulate firms' environmental performance (Chen et al., 2006; Kammerer, 2009). Moreover, Carrion-Flores and Innes (2010) suggest green innovation spurs demands for improved environmental performance. Accordingly, two hypotheses are proposed.

H3-a: Green product innovation positively affects environmental performance.
H3-b: Green process innovation positively affects environmental performance.

4. Green innovation and Firm performance

Green innovation through minimizing environmental impact, CO2, and waste efficiently helps firms avoid environmentalists' protests or penalties, increase productivity, improve corporate reputation, green image, and market performance, develop new markets, and achieve first-mover competitive advantages (Porter and van der Linde, 1995; Pujari, 2006; Mu et al., 2009). Additionally, Bonini and Oppenheim (2008) verify that eco-innovation practices on energy-efficient products help firms minimize waste and promote brands, which in turn efficiently stimulate market share and new business opportunities, being reflected through the case of Toyota Prius Hybrid which has become status symbols for green-labeling products strategies. Hence, following hypotheses are established.

H4-a: Green product innovation positively affects market share.
H4-b: Green product innovation positively affects reputation.
H4-c: Green process innovation positively affects market share.
H4-d: Green process innovation positively affects reputation.

5. Environmental performance and Firm performance

Better environmental performance has been widely proven to bring numerous sustainable benefits regarding firm performance such as low-cost, differentiation, better social reputation, and legitimization (Porter and van der Linde, 1995; Lopez-Gamero et al., 2009) as well as market share and profitability enhancement (Wahba, 2008). Obviously, firms with lower emission level and better waste treatment will be able to outperform rivals with first-mover advantages and more reliable green reputation; hence, environmental performance plays a critical role to firm sustainability (Claver et al., 2007). Recent studies also confirm better environmental performance beneficially helps firms attract more resources and social support as well as expand market opportunities (Jacobs et al., 2010). Therefore, following hypotheses are put forward.

H5-a: Environmental performance positively affects market share.
H5-b: Environmental performance positively affects reputation.

RESEARCH METHODOLOGY

1. Taiwan hybrid vehicle industry

In recent years, the transport sector alarmingly accounts for 27% of the world's total energy consumption and 33.7% of total green house gas emission (Tie and Tan, 2013). Additionally, fossil fuel scarcity and environmental pressures keep increasing dramatically to unsustainable levels in a global scale (Nilsson et al., 2012). In this context, energy saving, air pollution, and

CO2 emission in the transport sector has become extremely important issues and principal governance challenges (Hui, 2010).
The Taiwanese hybrid vehicle industry was chosen for several crucial reasons. First, in addition to alarming global warming and numerous environmental threats, Taiwan is currently suffering from heavy environmental burdens due to limited land and a strong emphasis on economic development and serious air pollution and CO2 emission derived from vehicle exhaust, which in turn has placed significant pressures on vehicle manufacturers to develop environmentally friendly and energy-efficient vehicles (Pongthanaisawan and Sorapipatan, 2010). Second, Taiwan hybrid vehicle industry possesses much potential for development since manufacturing firms are becoming more social responsible and green-conscious under significant pressures from environmental regulations and green customers. Moreover, being one of the major vehicle producers worldwide, Taiwan is now attempting to apply advanced technologies in new product and process development for not only environmental protection but also industrial advancement (Chou and Hsiao, 2005). Finally, since sharing common development patterns with regional developing countries; the achieved experience in Taiwan usefully shed light on future firm growth in Asia.

2. Data collection

For empirical analysis, this study aimed to collect data from firms that were listed in Taiwan's Top 5000 largest enterprises by Taiwan Ministry of Economic Affairs in 2012. The firms chosen must have achieved certain green levels and well-recognized in the market. Survey questionnaire was employed as main research instrument. The chosen items were adopted from existing literature related to green innovation, market demand, environmental performance, and firm performance. Prior to data collection, the questionnaire was pre-tested for content validity in two stages. First, based on the idea of Cooper and Schindler (2001), two scholars in the field of green supply chain were asked to assess all construct items for ambiguity, clarity, and appropriateness; then, the questionnaire was further modified. Second, the questionnaire was mailed to three management executives in the hybrid vehicle industry to review the structure, readability, ambiguity and completeness.

Using random sampling method, questionnaires were sent to respondents that were retailers, wholesalers, and component sale firms in the automobile industry in Taiwan through post, e-mails, and fax. Out of 1000 distributed questionnaires, 223 valid questionnaires were obtained, achieving the response rate of 22.3%.

3. Questionnaire design and measures

The questionnaire (as in Table 1) contained five sections. The first section comprised basic descriptive data of participant firms. The following sections were the measurements of market demand, green innovation, environmental performance, and firm performance. All items were assessed using Likert 5-point scale (1= "strongly disagree", 5= "strongly agree").

4. Methodology

Structural Equation Modeling (SEM) methodology was utilized to test the proposed hypotheses and the theoretical model in Figure 1. SEM was selected for its capability of

incorporating incorporate both latent and observed (i.e. measured) variables while other multivariate techniques were only based on observed measurements (Byrne, 2006).

Since the measurement scales for market demand, green innovation, environmental performance, and firm performance in this research were integrated from the extant literature, it was necessary to test the appropriateness of these scales (Wong and Law, 2002). As such, this study adopted exploratory factor analysis (EFA) to test construct items, using maximum likelihood method with varimax rotation. Then, AMOS 5.0 was employed as the main statistical assessment tool. To demonstrate a reasonable model fit, a number of fit indicators were computed, including Chi-square/degrees of freedom (χ^2/d.f), Goodness-of-fit Index (GFI), Adjusted Goodness-of-fit Index (AGFI), the Normed Fit Index (NFI), Comparative Fit Index (CFI), and Root Mean Square of Approximation (RMSEA).

EMPIRICAL RESULTS AND DISCUSSIONS

1. Descriptive analysis

The main purpose of conducting demographic characteristics analysis was to briefly summarize participant firms' background features. Regarding participant firms' background, the results showed that the majority of respondent firms were with more than 25 years of operation (41.3%), turnover rate from $NT 1.5 to 5 billion (54.3%), capital of more than $NT 70 million (69.4%), and more than 201 employees in total (69.5%).

Table 1. Questionnaire constructs and variables

Constructs	Variables	References
Market demand	Customer demand	Oltra & Saint Jean (2009)
	External pressures	Zhou et al. (2009)
	Competitor pressures	
Green innovation	Green product innovation	Chen et al. (2006), Chen (2008),
	Green process innovation	Huang & Wu (2010)
Environmental performance	Reduction of air emission	Wang et al. (2004)
	Reduction of hazardous waste/scrap	Awasthi et al. (2010)
	Less consumption of gasoline/fuel	Chiou et al. (2011)
	Environmental compliance	
Firm performance	Market share	Rex & Baumann (2007)
	Reputation	Li et al. (2010)

In accordance with research purposes, the mean and standard deviations were calculated to further explain the current situation of market demand, green innovation, environmental performance, and firm overall performance in Taiwan hybrid vehicle industry. The achieved mean values in Table 2 range from 3.74 to 4.44, indicating that a wide range of Taiwanese hybrid vehicle manufacturers have already implemented and made great efforts in enhancing green innovation (4.36) and environmental management (4.44) in daily operational activities, thus have gained considerable achievements regarding firm performance (4.33). However, although market demand (3.90) has attracted increasing attention from business operators, its role on green innovation and firm performance has not been sufficiently emphasized.

2. Reliability and validity

Since the measurement scales for research constructs were adopted from previous literature, the constructs were indicated to have content validity (Wong and Law, 2002). In order to assess the scale appropriateness, this study additionally adopted an exploratory analysis (EFA), using maximum likelihood method with varimax rotation. In terms of market demand, the EFA results of 19 items showed that KMO and Bartlett test were significant (KMO=0.95, p<0.000) and two factors with eigenvalue greater than 1 were extracted. Out of 19 items, the first 7 items achieved factor loading greater than 0.5 on factor 1, indicating customer demand pressure. 12 remaining items achieved factor loading greater than 0.5 on factor 2, representing competitor pressures. Similarly, EFA results for other constructs' measurement scales showed that green innovation was consisted of green production innovation (6 items) and green process innovation (6 items). Environmental performance (5 items) and firm performance (10 items) was proven to be single factors.

Table 2. Descriptive statistics, Reliability and validity tests

Constructs	Mean	Std. Dev.	Cronbach's α
Market demand	3.90	0.91	0.899
Customer demand pressures	4.11	0.85	
External pressures	3.86	1.03	
Competitor pressures	3.74	1.09	
Green innovation	4.36	0.79	0.884
Green product innovation	4.37	0.76	
Green process innovation	4.36	0.74	
Environmental performance	4.44	0.67	0.962
Firm performance	4.33	0.77	0.885
Market share	4.23	0.89	
Reputation	4.43	0.73	

The measurement model was then tested for reliability by Cronbach's α values. As shown in Table 2, the achieved Cronbach's α values for market demand, green innovation, environmental performance, and firm performance respectively were 0.90, 0.88, 0.96, and 0.89, which were all greater than the threshold 0.7 (Nunnally, 1978; Bagozzi and Yi, 1988), indicating high internal consistency, thus reliability for all measurement indicators.

3. SEM results

3.1 Model fit test

A set of goodness-of-fit indices were calculated to demonstrate a reasonable model fit. The results of Table 3 showed the achieved values ($\chi 2/df = 2.515$, GFI= 0.99, AGFI= 0.92, NFI= 0.99, CFI= 0.99, RMSEA= 0.083), were all greater than the recommended values, indicating good model fit of the final structural model.

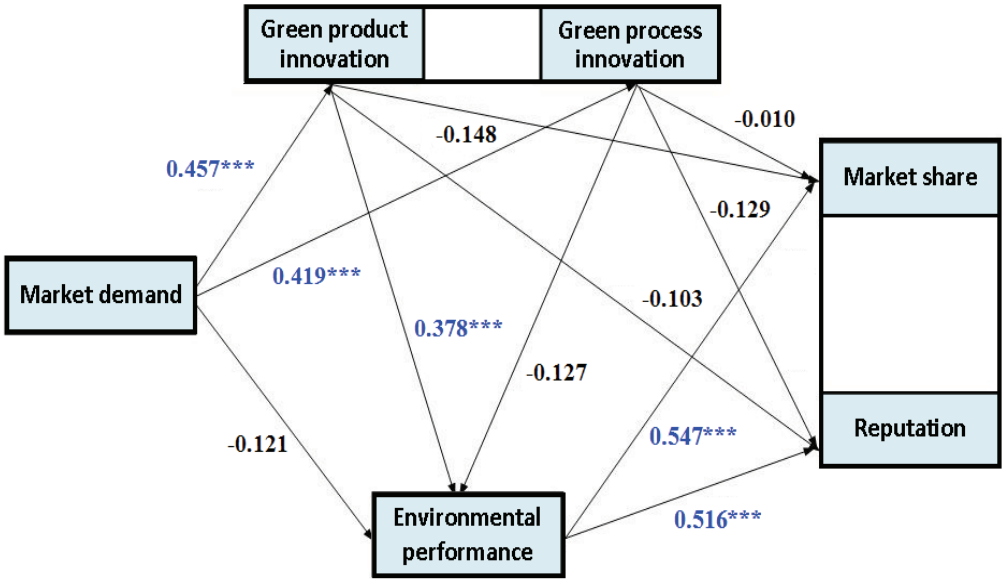
Table 3. Model fit test

	χ^2/d.f	GFI	AGFI	NFI	CFI	RMSEA
Final structural model	(5.030/2)= 2.515	0.993	0.922	0.993	0.996	0.083
Recommended values	<3	>0.9	>0.8	>0.9	>0.9	<0.1

3.2 SEM results

The structural model was used to test the proposed hypotheses and the theoretical model in Figure 1. AMOS 5.0 was utilized as the main statistic analysis tool. The final structural model with all path coefficients was illustrated in Figure 2.

The achieved results supported five out of 11 proposed hypotheses, as shown in Table 4. Specifically, market demand was found to have significant impact on green product innovation (β=0.457, p<0.001), green process innovation (β=0.419, p<0.001); hence, hypotheses H1a and H1b were supported. Additionally, green product innovation had significant impact on environmental performance (β =0.378, p<0.001), supporting hypothesis H3a. Finally, environmental performance exerted significant effects on market share (β=0.547, p<0.001) and reputation (β=0.516, p<0.001), confirming hypotheses H5a and H5b.



Note: p<0.001***

Figure 2. SEM results with path coefficient between latent constructs

However, in contrast with research expectation, no significant relationships were found between market demand and environmental performance (β=-0.121, p=0.056), green process innovation and environmental performance (β=-0.127, p=0.170), which in turn disapproved hypotheses H2 and H3b, respectively. Most surprisingly, the link between green innovation and firm performance was found to be non-significant, reflected through non-significant path coefficients between green product innovation and market share (β=-0.148, p=0.092) as well as reputation (β=-0.103, p=0.233), simultaneously between green process innovation and market share (β=-0.010, p=0.909) and reputation (β=-0.129, p=0.120), indicating hypotheses H4a, H4b, H4c, and H4d were rejected.

Table 4. Hypothesis support: Path coefficients (β)

	Hypothesis	β	Supported
H1-a	Market demand → Green product innovation	0.457***	Yes
H1-b	Market demand → Green process innovation	0.419***	Yes
H2	Market demand → Environmental performance	0.121	No
H3-a	Green product innovation → Environmental performance	0.378***	Yes
H3-b	Green process innovation → Environmental performance	0.127	No
H4-a	Green product innovation → Market share	0.148	No
H4-b	Green product innovation → Reputation	0.103	No
H4-c	Green process innovation → Market share	0.010	No
H4-d	Green process innovation → Reputation	0.129	No
H5-a	Environmental performance → Market share	0.547***	Yes
H5-b	Environmental performance → Reputation	0.516***	Yes

Note: $p<0.001$***

CONCLUSIONS, DISCUSSIONS, AND RECOMMENDATIONS

Concerning the impact of market demand, the empirical findings prove that market demand have a significant impact on green innovation. These findings are consistent with previous studies that market demand acts as the key factor stimulating green innovation through inducing successful new product development and enforcing firms to implement flexible manufacturing strategies (Chiou et al., 2011; Hsu and Hu., 2011). Nonetheless, no significant relationship was found between market demand and firms' environmental performance. After discussions with experts, this study finds that despite customer demand for vehicles with better energy-efficiency, lower air pollution and prices; however, without the implementation of green innovation, firms cannot achieve higher level of environmental performance as expected.

Regarding the impact of environmental performance on firm performance, the results strongly support previous studies (Claver et al., 2007; Wahba, 2008; Jacobs et al., 2010) by confirming its benefits in assisting firms in leading the market, outperforming rivals with of low-cost and differentiated strategies, achieving more reliable green reputation, attracting more customers, and expanding market share.

Worth noticing, this study found that green innovation had partly positive impact on environmental performance through green product innovation, but not through green process innovation. After discussion with industrial experts, green product innovation is perceived to easily and directly help firms satisfy green requirements and enhance environmental performance since being closely associated with eco-targets; meanwhile, improving the manufacturing process is considered costly projects and is not easy to implement.

Surprisingly, this study found out no significant relationships between firms' green innovation and firm performance, which in turn contributes to the existing debate in the literature. It is noted that the implementation of new green manufacturing processes and product development can be costly, which in turn sharply increase product prices. Hence, although green innovation helps firm address environmental issues, it is not ensured that the manufactured green products can truly achieve market success and higher reputation (Pujari,

2006) since customers' preferences and actual purchase behaviors sometimes conflict with their price-consciousness (Prakash, 2002; Zhou et al., 2009). Moreover, Rehfeld et al. (2007) state that there is not always strong stimulus for eco-innovation from the demand side since green products are still expensive and not all customers are willing to trade off product qualities for green attributes.

Regarding these non-significant results, after discussions with experts, these findings can be explained due to the small sample size in this study, which in turn may constraints the evaluation. Moreover, since the Taiwanese hybrid vehicle industry is still in its initial stage of replacing fuelled vehicles, customers remain low perception and favor toward its green benefits, thus results in low purchase intention and low reputation.

This research is the first of its kind to investigate the links among market demand, green innovation, environmental performance, and firm performance in Taiwan hybrid vehicle industry, which is now an important and promising industry in Taiwan society and one of the major vehicle producers worldwide. Hence, the findings beneficially contribute to the knowledge of green innovation and green demands, which in turn effectively assist firms in carrying out outstanding, differentiated, and feasible strategies to achieve better sustainability and market leadership in this competitive market.

With achieved results, this study has provided the hybrid vehicle industry in particular and all businesses in general with useful managerial focuses and guidelines for performance enhancement. By confirming the significant impact of market demand on firms' green innovation, this study strongly recommends firms to make more efforts to understand customer needs and expectations in order to better anticipate their changing preferences and align green product innovation initiatives with consumer values to promptly satisfy market demand, thus gain better performance. In addition, since market demand can be influenced by price, firms should attempt to reduce any unnecessary costs in the entire manufacturing processes to maintain stable and reasonable prices in consistent with customer needs. Moreover, since green innovation has been indicated to be an important strategy for hybrid vehicle firms to gain better sustainable advantages and attract more customers, this study implies that firms should pay more attention to excel their competencies in innovating their products and processes once attempting to lead the market. Finally, environmental performance has been proven to be adequately crucial to firm performance stimulation and business success, implying that hybrid vehicle manufacturing firms should emphatically enhance product quality and attributes in a green manner in order to produce new environmentally friendly vehicles that significantly help firms surpass competitors, grasp more customer attention, satisfaction, and purchase intention, and promote market leadership.

Nonetheless, this research remains limitations. The use of single industry has partly restricted finding generalization. Hence, future studies can expand the research scope to other Asian or international hybrid vehicle markets to achieve better findings. Additionally, since small sample size has considerably restricted the findings, this study strongly encourage the continuous collecting of data in order to complete the investigation in a more holistic way.

REFERENCES

1. Bagozzi, R.P., and Yi, Y. (1988), "On the evaluation of structural equation models", *Journal of the Academy of Marketing Science*, Vol. 16, pp. 74-94.
2. Berchicci, L., and Bodewes, W. (2005), "Bridging environmental issues with new product development", *Business strategy and the Environment*, Vol. 14 No. 5, pp. 272-285.
3. Berthon, P., Hulbert, J.M., and Pitt, L.F. (1999), "To serve or create? Strategic orientations toward customers and innovation", *California Management Review*, Vol. 42 No. 1, pp. 37-52.
4. Bonini, S.M.J., Oppenheim, J.M. (2008), "Helping green products grow", *McKinsey Quarterly*, 1-8.
5. Byrne, B.M. (2006), *Structural Equation Modeling with AMOS: Basic concepts, applications, and programming*, Lawrence Erlbaum, Mahwah, NJ.
6. Carrillo-Hermosilla, J., del Rio, P., and Konnola, T. (2010), "Diversity of eco-innovations: Reflections from selected case studies", *Journal of Cleaner Productio*n, Vol. 18, pp. 1073-1083.
7. Carrion-Flores, C.E., and Innes, R. (2010), "Environmental innovation and environmental performance", *Journal of Environmental Economics and Management*, Vol. 59, pp. 27-42.
8. Chang, N.J., and Fong, C.M. (2010), "Green product quality, green corporate image, green customer satisfaction, and green customer loyalty", *African Journal of Business Management*, Vol. 4 No. 13, pp. 2836-2844.
9. Chen, Y.S. (2008), "The driver of green innovation and green image: Green core competence," *Journal of Business Ethics*, Vol. 81, pp. 531-543.
10. Chen, Y.S., Lai, S.B., and Wen, C.T. (2006), "The influence of green innovation performance on corporate advantage in Taiwan", *Journal of Business Ethics*, Vol. 67 No. 4, pp. 331-339.
11. Chen L.Y., Hwa M.Y., Lee Y.C., Yu T.Y., and Wu C.T. (2008), "Particle size distribution of exhaust stream from in-use motorcycles", *Journal of Environmental Engineering and Management*, Vol. 18 No. 6, pp. 397-402.
12. Chiou, T.Y., Chan, H.K., Lettice, F., and Chung, A.H. (2011), "The influence of greening the suppliers and green innovation on environmental performance and competitive advantage in Taiwan", *Transportation R*esearch Part E (Article in press).
13. Chou J.R., and Hsiao S.W. (2005), "Product design and prototype making for an electric scooter", *Materials and Design*, pp. 439-449.
14. Claver, E., López, M.D., Molina, J.F., and Tarí, J.J. (2007), "Environmental management and firm performance: A case study", *Journal of Environmental Management*, Vol. 84, pp. 606-619.
15. Cooper, D.R., Schindler, P.S. (2001), Business Research Method, seventh ed. McGraw-Hill Book Co.
16. Du, C., and Liu, Y. (2011), "Constructing energy saving system based on low-carbon economy," *Energy Procedia*, Vol. 5, pp. 1998-2002.
17. Fontaras, G., and Samaras Z. (2007), "A quantitative analysis of the European automakers' voluntary commitment to reduce CO2 emissions from new passenger cars based on independent experimental data", *Energy Policy*, Vol. 35, pp. 2239-2248.
18. Halila, F., and Rundquist, J. (2011), "The development and market success of eco-innovations: a comparative study of eco-innovations in Sweden", *European Journal*

of Innovation Management, Vol. 14 No. 3, pp. 278-302.
19. Horbach, J., Rammer, C., and Rennings, K. (2012), "Determinants of eco-innovations by type of environmental impact - The role of regulatory push/pull, technology push and market pull", *Ecological Economics*, Vol. 78, pp. 112-122.
20. Huang, Y.C., and Wu, Y.C.J. (2010), "The effects of organizational factors on green new product success. Evidence from high-tech industries in Taiwan," *Management Decision*, Vol. 48 No. 10, pp. 1539-1567.
21. Hsu C.W., and Hu A.H. (2011), "Applying hazardous substance management to supplier selection using analytic network process", *Journal of Cleaner Production*, Vol. 17 No. 2, pp. 255-264.
22. Hui, S. (2010), "Multi-objective optimization for hydraulic hybrid vehicle based on adaptive simulated annealing genetic algorithm", *Engineering Applications of Artificial Intelligence*, Vol. 23, pp. 27-33.
23. Iwu, C.G. (2010), "Impact of product development and innovation on market share", *African Journal of Business Management*, Vol. 4 No. 13, pp. 2659-2667.
24. Jacobs, B.W., Singhal, V.R., and Subramanian, R. (2010), "An empirical investigation of environmental performance and the market value of the firm", *Journal of Operations Management*, Vol. 28 No. 5, pp. 430-441.
25. Juma, N., and Payne, G. (2004), "Intellectual capital and performance of new venture high-tech firms", *International Journal of Innovation Management*, Vol. 83, pp. 297-318.
26. Kammerer, D. (2009), "The effects of customer benefit and regulation on environmental product innovation. Empirical evidence from appliance manufacturers in Germany", *Ecological Economics*, Vol. 68, pp. 285-2295.
27. Klassen, R.D., and Whybark, D.C. (1999), "The impact of environmental technologies on manufacturing performance," *Academy of Management Journal*, Vol. 42 No. 5, pp. 599-615.
28. Koellinger, P. (2008), "The relationship between technology, innovation, and firm performance: Empirical evidence from e-business in Europe", *Research Policy*, Vol. 37, pp. 1317-1328.
29. Kwansa F.A., Mayo, C., and Demirciftci, T. (2008), "Chapter 8 - The importance of intangible assets: trends and patterns". *Handbook of Hospitality Strategic Management*, pp. 181-202.
30. Li, Y., Su, Z., and Liu, Y. (2010), "Can strategic flexibility help firms profit from product innovation?", *Technovation*, Vol. 30, pp. 300-309.
31. Lopez-Gamero, M. D., Molina-Azorin, J. F., and Claver-Cortes, E. (2009), "The whole relationship between environmental variables and firm performance: Competitive advantage and firm resources as mediator variables", *Journal of Environmental Management*, Vol. 90, pp. 3110-3121.
32. Martenson, R. (2007), "Corporate brand image, satisfaction and store loyalty: A study of the store as a brand, store brands and manufacturer brands", *International Journal of Retail Distribution Managemen*t, Vol. 35 No. 7, pp. 544-555.
33. Meeus, M.T.H., and Edquist, C. (2006), "Introduction to part 1: Product and process innovation", in Hage, J., and Meeus, M.T.H. (Eds.), *Innovation, science and institutional change*, Oxford: Oxford University Press.
34. Mu, J., Peng, G., and MacLachlan, D.L. (2009), "Effect of risk management strategy on NPD performance", *Technovation*, Vol. 29, pp. 170-180.
35. Nilsson, M., Hillman, K. and Magnusson, T. (2012), "How do we govern sustainable

innovations? Mapping patterns of governance for bio-fuels and hybrid-electric vehicle technologies," *Environmental Innovation and Societal Transitions*, Vol. 3, pp. 50-66.
36. Oltra, V., and Saint Jean, M. (2009), "Sectoral systems of environmental innovation: An application to the French automotive industry", *Technological Forecasting & Social Change*, Vol. 76, pp. 567-583.
37. Nunnally, J. C. (1978), *Psychometric Theory*, McGraw-Hill, New York, NY.
38. Pongthanaisawan, J., and Sorapipatana, C. (2010), "Limiting the fossil-fueled alternatives could be highly effective in forcing the market penetration of electric vehicles. Relationship between level of economic development and motorcycle and car ownerships and their impacts on fuel consumption and greenhouse gas emission in Thailand", Renewable and Sustainable Energy Reviews, Vol. 14, pp. 2966-2975.
39. Porter, M.E., and van der Linde, C. (1995), "Green and competitive: Ending the stalemate," *Harvard Business Review*, Vol. 73 No. 5, pp. 120-134.
40. Prakash, A. (2002), "Green marketing, public policy and managerial strategies", *Business Strategy and the Environment*, Vol. 11 No. 5, pp. 285-297.
41. Pujari, D. (2006), "Eco-innovation and new product development: understanding the influences on market performance," *Technovation*, Vol. 26 No. 1, pp. 76-85.
42. Rehfeld, K.M., Rennings, K., and Ziegler, A. (2007), "Integrated product policy and environmental product innovations: An empirical analysis," *Ecological Economics*, Vol. 61 No. 1, pp. 91-100.
43. Rex, E., and Baumann, H. (2007), "Beyond Eco-labels: what green marketing can learn from conventional marketing", *Journal of Cleaner Production*, Vol. 15 No. 6, pp. 567-576.
44. Rubik, E.F., Frankl, E.P. (2005), "The future of eco-labeling", Greenleaf Publishing, Sheffield: 60.
45. Tie, S.F., and Tan, C.W. (2013), "A review of energy sources and energy management system in electric vehicles", *Renewable and Sustainable Energy Reviews*, Vol. 20, pp. 82-102.
46. Wahba, H. (2008), "Does the market value corporate environmental responsibility? An empirical examination," *Corporate Social Responsibility and Environmental Management*, Vol. 15, pp. 89-99.
47. Wang, Y., Lo, H., and Yang, Y. (2004), "The constituents of core competencies and firm performance: Evidence from high-technology firms in China", *Journal of Engineering and Technology Management*, Vol. 21, pp. 249-280.
48. Wei, Y., and Morgan, N.A. (2004), "Supportiveness of organizational climate, market orientation, and new product performance in Chinese firms", *Journal of Product Innovation Management*, Vol. 21, pp. 375-388.
49. Wong, C.S., and Law, K.S. (2002), "Development of an emotional intelligence instrument and an investigation of its relationship with leader and follower performance and attitudes", *The Leadership Quarterly*, Vol. 13, pp.1-32.
50. Zhou, K.Z., Brown, J.R., and Dev, C.S. (2009), "Market orientation, competitive advantage, and performance: a demand-based perspective", Journal of Business Research, Vol. 62, pp. 1063-1070.
51. Zhu, Q., and Sarkis, J. (2004), "Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises," *Journal of Operations Management*, Vol. 22, pp. 265-289.
52. Zhu, Q., Sarkis, J., and Lai, K.H. (2008), "Green supply chain management implications

for closing the loop", *Transportation Research Part E: Logistics and Transportation Review*, Vol. 44 No. 1, pp. 1-18.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

DRIVERS FOR SUSTAINABLE GREEN SUPPLY CHAIN – CASE OF THE INDIAN AUTOMOBILE INDUSTRY

Saroj Koul, Jindal Global Business School, India
Email: skoul@jgu.edu.in

yatish prasad dasari, Jindal Global Business School, India
Email: 11jgbs-ypdasari@jgu.edu.in

ABSTRACT

Purpose: *De-licensing in 1991 put the Indian automobile industry on a new growth trajectory attracting foreign auto giants to set up their production facilities in the country to take advantage of various benefits it offers. The growth in this sector continues to be a threat to the environmental degradation. In light of future environmental challenges posed, this study explores drivers and building strategic framework for Green Supply Chain Management (GrSCM) in automobile sector from the Indian context.*
Design/methodology/approach: *The literature is reviewed by studying articles published in journals during 1990 – 2013, company sustainability reports. Further Expert interviews and survey is used for collection of data from employees working in Original Equipment manufacturers and parent companies.*
Findings: *Raw material dependency, top management commitments, greenhouse gas emissions, reverse logistics, cost of operations, peer influence is the variables which will act as drivers for sustaining Green Supply Chain management. The knowledge penetration level about the subject of Green Supply Chain management among the Engineers and Managers has been found satisfactory.*
Originality/value: *This research project apart from providing valuable insights to managers and top management will also be valuable to new entrant in this sector. The project carried is a first of a kind of project in the country that involves the exhaustive study of literature review followed by Company Sustainability reports and Primary Research for identifying Drivers of Green Supply Chain Sustainability.*

Classifications: Literature review
Keywords: Green Supply Chain Management, strategic framework, Automobile industry, India.

INTRODUCTION

De-licensing in 1991 has put the Indian automobile industry on a new growth trajectory by providing various benefits and attracting foreign auto giants to set up their production facilities in the country. The growing middle class population, greater earning power coupled with strong technological capability has been propelling automobile demand for past few years. Despite economic slowdown, the Indian automobile sector has seen a high growth especially in the passenger cars segment (Indian Automobile Sector Analysis, RNCOS, 2009 [1]). Further, the country has an installed capacity of 24.27 million units with 600 organised players (contributing 77% total production) and 5800 unorganised players (Profile of Automobile Industry in India, SIAM, 2010-11 [2]). In the Indian Automobile Sector, the OEM players have the largest market share followed by replacement and exports. The production stood at 1,79,16,035 units for the year 2010-11 vis-à-vis corresponding

1,55,13,156 units for the domestic sales and 23,39,333 units for export (Indian Automobile Sector Analysis, RNCOS,2009 [1]; Profile of Automobile Industry in India, SIAM, 2010-11 [2]).
In section 2 below we attempt to examine the literature so as to understand the factors critical to the Automobile industry.

LITERATURE REVIEW

1. Definition

Since an attempt is made to understand the evolution of Green Supply Chain through the literatures from SCM. It is important to quote the differing lexicons on SCM and GrSCM. The term 'supply chain' was coined in the mid 70's. Banbury in 1975 used 'supply chain' as a term of passing on electricity towards the ultimate consumer. It was not until the 1980's, however, that the term 'supply chain management' came into context. Stevens in 1989 defined supply chain management as the integration of inbound to outbound ends of the business business functions involving the flow of materials and information (Fortes, [38]).

In the early 1990's, supply chain management evolved dramatically with the increasing importance managing relationship within the organization and with other suppliers (Harland,[36]). Slack (1991) and Christopher (1992) explains that the reason for this was the emergence of a globalised marketplace (Fortes,[38]). Green Supply chain from practitioner's point of view can be defined as integrating the ideas of green purchasing, total quality management, customer focus, continuous improvement and zero waste; life cycle analysis; environmental marketing and so on (Purba Rao,[53], Handfield and Nichols,1999) .The above factors like green purchasing, total quality management, customer focus, continuous improvement, zero waste, life cycle analysis, environmental marketing should be used by companies for empowering its employees (Kumar et al, [42]) .were integrated as The "quality revolution in the late 1980's and the supply chain revolution in the Green supply chain have been further defined as a way in which innovations in supply chain management and industrial purchasing may be considered in the context of the environment (Green et al, 1998[41]). Integrating environmental thinking into a supply chain management, including product design, material resourcing and selection, manufacturing processes, delivery of the final product to the customer as well as end of life management of these product after its useful life (Nimawat, Dheeraj, [64]; (Srivastava, [58]).

Different perspectives on the definition shows that clear consensus on the definition is yet to be achieved. Further Automotive industrial production growth has caused a significant regional and international ecological burden (Gonza´lez et al, [60]). The growth in this sector comes continues to be a threat to environmental degradation which as alarmed governments and corporate worldwide following fast realization of the deteriorating climatic conditions. Global warming caused by greenhouse gases, ozone layer depletion, haze over Asian countries, fast melting of glaciers, generation of huge amounts of liquid and solid waste, rising air, water and soil pollution levels and irreparable loss of biodiversity are impacts that can be attributed to the coordinated activities of organizations in a supply chain. Much of this arises from manufacturing organizations that continue to produce large amounts of unnecessary waste or emissions rather than investing in better technologies or practices to prevent its generation at the source (Berchicci, [3]).

Green supply chain management (GSCM) has gained momentum in recent years as a potential tool to counter the detrimental impacts of the supply chains and Western countries have adopted

very stringentmeasures to arrest the damage caused by large, global supply chains which are energy and capital inefficient and complex in design.

2. GrSCM Vs Conventional SCM

GrSCM and Conventional SCM differ in various ways. GrSCM takes considerations of ecology as well as economy as an objective, while Conventional SCM is usually concentrated on economy as a single objective. GrSCM are green, integrated and ecologically optimized while Conventional SCM does not take into consideration human toxicological effects (Luthra et al,[45]). Conventional SCM concentrates more on controlling the final product; no matter harmful its effects are to the environment during production and distribution. Ecological requirements are key criteria for products and productions and at the same time the company must assure its economic sustainability by staying competitive and profitable.An attempt to differentiate by (Luthra, Kumar.V, Kumar.S,Haleem,[45]; Ho Johnny, Shalishali, Maurice, Tseng, & Ang, 2009) as in Table 1.

Table 1: "Difference between the Green Supply Chain Management and Conventional Supply Chain Management" [Luthra, Kumar.V, Kumar.S, Haleem, 2011]

S. No	Characteristics	Green Supply Chain Management	Conventional Supply Chain Management	Researcher's
1	Objectives	Ecological and Economic	Economic	Beamon (1999)
2	Ecological Optimization	High Ecological Impacts	Integrated Approach Low ecological impacts	Gilbert (2000)
3	Supplier Selection Criteria	Ecological Aspects Long term relationship	Price Switching suppliers quickly Short term relationship	Ho Johnny et al. (2009)
4	Cost Pressure	High	Low	
5	Flexibility	Low	High	
6	Speed	Low	High	

3. GrSCM Vs Lean manufacturing methods:

Lean manufacturing is closely associated with Green Production as there is an overlap between the goals and drivers for both processes. Various lean manufacturing techniques are JIT, Six sigma, ISO 9000 & 14000. The table below shows comparison between green supply chain versus lean manufacturing techniques. It can be seen that GrSCM has more benefits when compared with lean manufacturing techniques (Table 2).

Table 2: Comparison between Lean manufacturing process vs Green manufacturing process [Bhateja et al, 2011]

Factors	Lean Manufacturing			Green Manufacturing
	JIT	SIX Sigma	ISO 9000 & ISO 14000	
Eliminate Defects	*	*		*
Reduction of Cost	*	*		*
Quality Improvement	*	*		*
Quality Standards			*	*
Improve Efficiency	*	*		*
Customers Satisfaction	*	*		*
Reduced Resource Consumption		*		*
Reducing CO2 emissions in manufacturing processes				*
Recycling programs for raw materials				*
Recycling programs for reusable components parts				*
Remanufacturing Programs				*

4. Green Design:

Green Design is the systematic consideration of design issues associated with environmental safety and health over the full product life cycle during new production and process development (Fiksel 1996). The scope of Green Design comprises many disciplines such as environmental risk management, product safety, occupational health and safety, pollution prevention, resource conservation and waste management (Srivastava,[58]). The green design takes care of selection of materials which are environmental friendly. However if the materials are not readily available appropriate composition should be specified to make the new desired material.

5. Green Manufacturing:

Green manufacturing needs to meet evolving definitions of "clean", "greener" products demanded by customers, developing recycling schemes, minimizing materials in packaging and choosing materials that have less environmental impact (Richards, [57]).Other definition of Green manufacturing given by (Chien et al., [20]) says its a manufacturing mode designed to minimize the environmental impact in the manufacturing processes of products, and the adoption of green manufacturing helps to reduce waste and pollution.Green manufacturing is also sometimes referred to initiatives for efficient use of energy, materials with an aim for eliminating pollution and waste, hence Green Manufacturing can be also referred to as "clean technologies" (Baines etall, [64]; Chiang & Tseng, 2005; Mohanty & Deshmukh, 1998; Porter & van der Linde, 1995; Rusinko, 2007; Sangwan, 2006; Sarkis & Cordeiro, 2001; Seliger & Zettl, 2008; Vachon, 2007). Reduction or elimination of hazardous substances (Cd, Pb, PBBE etc), reduction in consumption of energy (standby and in operation), recyclability (disassembly, mono-

materials, pressfit, glue, welding), packaging mass (elimination of PVC, PU, EPS) are some of the techniques which can be employed for green manufacturing (Ramakrishnan, [56]).

6. Reverse logistics:

Beamon (1999) defined Reverse Logistics (RL) as the opposite of traditional or forward logistics (Krishna et al, [52]). Dowlatshahi (2000) and Carter and Ellram (1998) define reverse logistics as a process where a manufacturer accepts previously shipped products from the point for consumption for possible recycling and re-manufacturing. Heavy industries that have complex supply chains should take into consideration the benefits of reverse logistics (RL). Collection is the first stage in the recovery process. Products are selected, collected and transported to facilities for remanufacturing (Srivastava, [60]). Thierry (1995) explained that products came from different sources and should be brought to product recovery facility to begin the converging process. Further in a highly competitive industry reverse Logistics provides firm with cost and strategic advantage (Fortes, [39]). The effective use of reverse logistics can help a firm to compete in its industry especially when confronted with intense competition and low profit margins (Dowlatshahi, [27]).

7. Waste Management:

(Bellmann and Khare, 1999) explained waste management as means of best utilization of waste material in a profitable way. In process industries there will be some wastage of production along with actual production. Different waste management issues come into context particularly around recycling and remanufacturing. Green Manufacturing in automobile ancillary industry is not only keeping control greenhouse gases emissions across the entire producing value chain. Keeping a tab on carbon emissions in house helps to standardize and improve processes, provide single platform to manage environmental compliance, consistently supply emission data for carbon credits trading, and strategically contribute towards greener manufacturing. Recycling is one of the critical activity that finds its application in automobiles. The economic and regulatory factors are main factors that drive recycling. It is mainly performed to retrieve the material content of used and non-functioning products economically (Srivastava et al [42]). Other way company can handle waste is by employing Integrated Waste Management which can be defined as selection of suitable techniques, technologies and management programs to achieve waste management goals and objectives (Nemerow and Agardy, [51]).

Green operations relates to all aspects related to product manufacturing /remanufacturing, usage, handling, logistics and waste management once the design has been finalized (Srivastava,[60]). So it can be safely said the above explained aspects of Green Manufacturing, Reverse logistics, Waste management forms the part of Green Operations.

8. Relationship between EMS and Environmental Performance

EMS in the automotive industry maybe due to regulatory policy pressure, supply chain pressures. ISO 14001 is a well known EMS certification. Inspite of certifications like ISO 14001 there exist other investment costs and barriers (P. Gonza´lez et al, [62], Watson et al, 2004). Employing ISO 14001 is not a sure shot gurantee to get improved environmental performance. Some also describe it as “ceremonial” activity (Cary Coglianese[19]). Others have stated that some organizations implement ISO 14001 for the purpose of signaling to the market that they are

environmentally responsible organizations, even though the proof of actual improvements in environmental performance is tenuous (P. Gonza´lez et al [62]).

The above discussion in the literature review can be summed up with the help of a theoretical framework (Figure 1). The proposed framework is based on the similar lines of the SCOR Model (Supply Chain Operations Reference). Since the SCOR model version 10.0 does not take into consideration research and technology development, product development the need is felt to propose a new model. Table 3 lists the variables that are derived from the literature review.

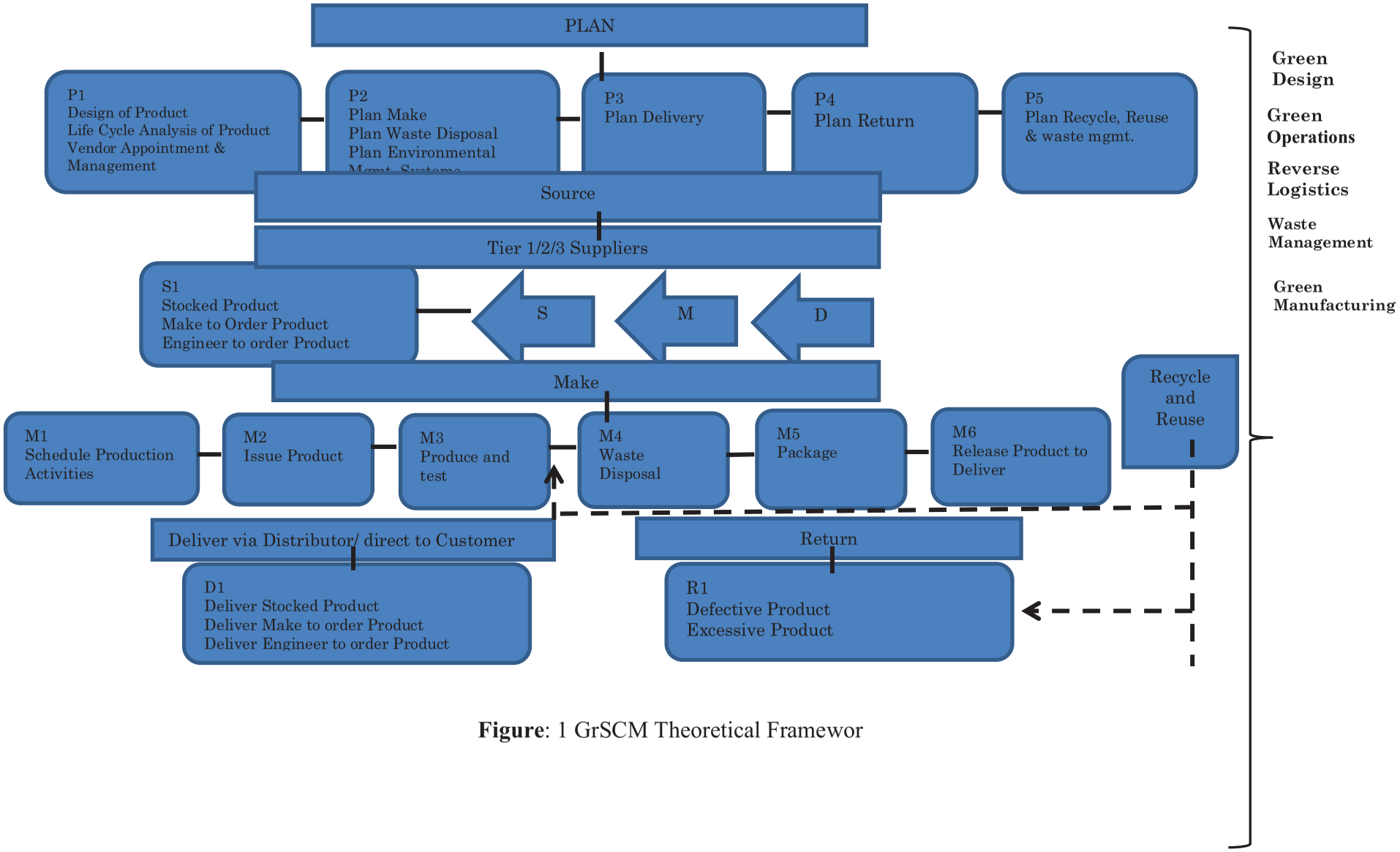


Figure: 1 GrSCM Theoretical Framewor

Table 3: Variable derived from the Literature Review

S.No	Author	Variables	Automobile related variables
1	Apratul Chandra Shukla, S.G. Deshmukh and Arun Kanda (2009);	1) Inbound Supply Chain Activities, 2) Outbound Supply Chain Activities, 3) Reverse Supply Chain Activities	All factors considered
2	Manish Choudhary, Nitin Seth (2011); Chien et al., (2007) Tan, et al., (2002); Hui, et al., (2001); Baines etall, (2012); Chiang & Tseng, (2005); Mohanty & Deshmukh, (1998); Porter & van der Linde, (1995); Rusinko, (2007); Sangwan, (2006); Sarkis & Cordeiro, (2001); Seliger & Zettl, (2008); Vachon, (2007)	1) Awareness seminars for suppliers and contractors; 2) Guiding suppliers to set up their own environmental programs; 3) Bringing together suppliers in the same industry to share their know-how and problems 4) Informing suppliers about the benefits of cleaner production and technologies; 5) Urging/pressuring suppliers to take environmental actions; 6) Selection of suppliers by environmental criteria	All factors considered
		1)Environmentally-friendly raw materials; 2) Substitution of environmentally questionable materials; 3) Taking environmental criteria into consideration; 4) Environmental design considerations; 5) Optimization of process to reduce solid waste and emissions; 6) Use of cleaner technology processes to make savings in energy, water, and waste; 7) Internal recycling of materials within the production phase; and 8) Incorporating environmental total quality management	All factors considered
		1) Environment-friendly waste management; 2) Environmental improvement of packaging; 3) Taking back packaging; 4) Eco-labelling; 5) Recovery of company's endof-life products; 6) Providing consumers with information on environmental friendly products and/or production methods	Factors listed at 4), 5), and 6 listed.
		1) Use of environmentallyfriendly transportation; 2) Taking back packaging	All factors considered
		1) Reduce waste and pollution; 2) Reduction or elimination of hazardous substances;	All factors considered

S.No	Author	Variables	Automobile related variables
		3) Reduction in consumption of energy; 4) Recyclability	
3	Claudia Colicchia, Marco Melacini and Sara Perotti (2011),Florida and Davison (2001),Hilliard (2006), King and Lenox (2001) and Veleva and Ellenbecker (2001), McKinnon et al. (2010),Rothenberg et al. (2005) and Turner and Houston (2009)	1) Eco-labelled product purchase adoption of environmental criteria into the supplier assessment system; 2) Environmental collaboration with suppliers	All factors considered
		1) Introduction of an energy manager; 2) Energy: choice of green electric power suppliers; 3) Energy: use of cogeneration plants; 4) Energy: energy efficiency improvement; 5) Energy: adoption of cleaner technology; 6) Fuel: district heating system; 7) Water: increase water system efficiency; 8) Water: waste water treatment; 9) Water: process optimization; 10) Material: reuse of materials; 11) Material: process optimization	All factors considered
		1) CO2 capture and storage; 2) Reduction of hydrofluorocarbons (HFC) and perfluorocarbons (PFC); 3) Use of CO2 refrigeration systems; 4) Treatment and control of postcombustion emissions; 5) Use of alternative fuels (e.g. cleaner fuels); 6) Treatment and recycle of hazardous wastes; 7) Process optimization; 8) Implementation of waste-to-energy process Waste reduction, reuse and recycling approaches	Factors from 2 to 8 considered

Figure 2 identifies the unique variables which as part of the framework as derived from Table 3 could be used as a framework in sustaining GrSCM.

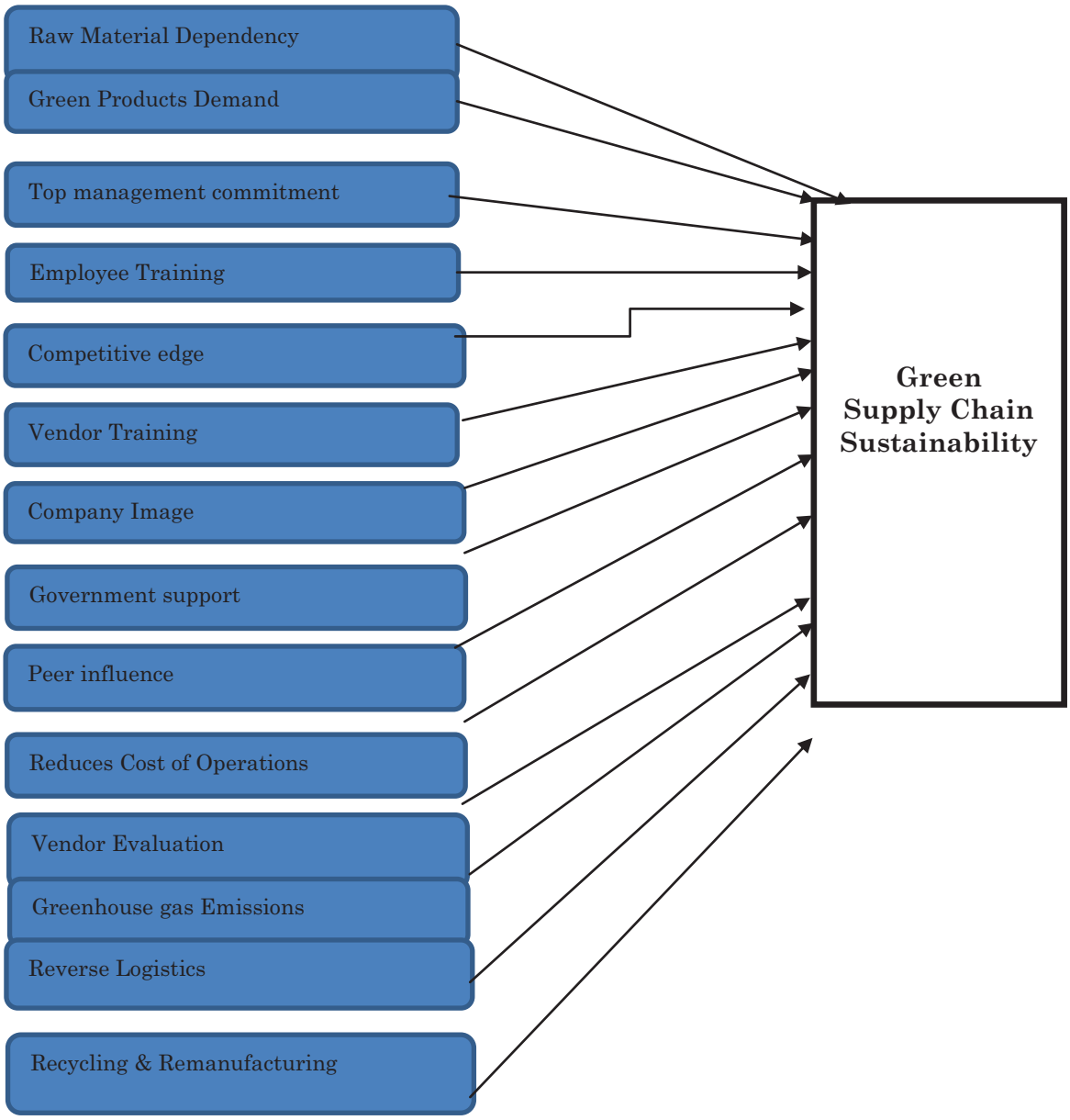


Figure 2: Unique variables for sustaining GrSCM.

CONCLUSIONS

The investigation 'What drivers are involved to sustain GrSCM for Automobile Companies in India?' has been carried out by a systematic review of GrSCM articles published in journals during 1990 – 2013. Eleven unique variables are identified for sustaining GrSCM. This include 1) GrSCM Awareness, 2) Raw material Dependency, 3) Green Products demand 4) Top management attitude towards initiate, appoint, train its employees and vendors 5) Impact on Competitive edge and Company Image, 6) Government support 7) Reduced Cost of Operation, 7) Peer influence, 8) Vendor Evaluation, 9) Greenhouse gas Emissions 10) Reverse Logistics, and 11) Recycling & Remanufacturing. From the Table 3, it can be concluded that these variables help build a

strategic framework for the drivers for implementing GrSCM in the Automobile industry. In the Indian context, to identify its validity and usability of all these variables is in progress by a survey questionnaire. The analysis of the result shall be updated by mid-April. 13.

REFRENCES

1. (2009). *Indian Automobile Sector Analysis.* RNCOS Industry Research Solutions.
2. Society of Indian Automobile Manufacturers (SIAM). (2010-11, January). *Profile of Automobile Industry in India*.
3. Berchicci, Luca.(2013). Environmental capabilities and corporate strategy: exploring acquisitions among US manufacturing firms. *Strategic Management Journal*, 1053-1072.
4. A.M.A. El Saadany, M. J. (2011). Environmental performance measures for supply chains. *Management Research Review*, 1202-1221.
5. Agency, U. S. (n.d.). The Lean and Green supply Chain. *Environmental Acounting Poject*.
6. Allen H. Hu, C.-W. H. (2010). Critical factors for implementing green supply chain management practice-An empirical study of electrical and electronics industries in Taiwan. *Management Research Review*, 586-608.
7. Andrea, T. J.-H. (2009). An Empirical Analysis of Green Supply Chain Management in the German Automotive Industry. *Wiley InterScience*, 19-132.
8. Anonymous. (n.d.). Evolution and growth of Indian auto industry.[www.india-reports.com/articles/Auto-Industry-India-Evolution-Growth].
9. Apratul Chandra Shukla, S. D. (2009). Environmentally responsive supply chains Learnings from the Indian auto sector . *Journal of Advances in management research*, 154-171.
10. Aragon-Correa, J. (2003). A Contingent resource-based view of proactive corporate environment strategy. *Academy of Management Review*.
11. Arvind, L. S. (2010). *Green manufacturing and china. Industry week.* Retrieved from www.industryweek.com.
12. Ashish Kumar Bhateja, R. B. (2011). Study of Green Supply Chain Management in the Indian manufacturing industries:A Literature review cum analytical approach for the measurement of performance. *International Journal of Computational Engineering & Management*, 2230-7893.
13. Balakrishnan Karthik, I. A. (2008). Indian Auto Supply Chain at the cross-roads. 1-33.
14. Barney, J. (1991). Firm resources and sustain competitive advantage. *Journal of Management*.
15. Baron, D. P. (1997). Integrated Strategy,trade policy, and global competition. *California management review*.
16. Bier Mann, F. ,.-S. (2007). Multi- Stake Holder Partnerships for Sustainable Development: Does the promise hold? *Human dimensions of global environmental change.* Amsterdam.
17. Bryunina Daria, K. S. (2011). *The Influence of Eco-labeled Products on Consumer Buying Behavior By focusing on eco-labeled bread.* Department of Sustainable Development of Society and Technology.
18. Buysse, K. a. (2003). Proactive environmental strategies:A stakeholder management perspective. *Strategic management journal*.
19. Cary Coglianese, J. N. (2006). *Leveraging the Private Sector: Management-Based Strategies for Improving Environmental Performance.* RFF Press Book.
20. Chiang, J. (2005). The impact of environmental characteristics on manufacturing strategy under cleaner production principles guidance. *The Journal of American Academy of Business*, 163-168.

21. Chien, M. K., & Shih, L. H. (2007). An empirical study of the implementation of green supply chain management practices in the electrical and electronic industry and their relation to organizational performances. *International Journal of Environment Science and Technology*, pp. 383-394.
22. Choudary Manish, S. N. (2011). Integration of Green Practices in Supply Chain Environment The practices of Inbound, Operational,Outbound and Reverse logistics. *International Journal of Engineering Science and Technology*, 4985-4992.
23. Claudia Colicchia, M. M. (2011). Benchmarking supply chain sustainability: insights from a field study. *Benchmarking: An International Journal*, pp.705 - 732.
24. Clemens Hepperlea, R. O. (2011). TEMPORAL ASPECTS IN LIFECYCLE-ORIENTED PLANNING OF PRODUCT-SERVICE-SYSTEMS. *Research into Design — Supporting Sustainable Product Development*, 338-346.
25. Dayna, S. (2008). The Automotive Industry Supply Chain:Developing Strategies for Green.
26. Diane Holt, A. G. (2009). An empirical study of green supply chain management practices amongst UK manufacturers. *Journal of Manufacturing Technology Management*, 933-956.
27. Diane Mollenkopf, H. S. (2010). Green, lean, and global supply chains. *International Journal of Physical Distribution & Logistics Management*, 14-41.
28. Dowlatshahi, S. (2000). Developing a Theory of Reverse Logistics. *INTERFACES*, pp.143-155.
29. E.Walsh, W., & Wellman, M. P. (2003). Decentralized Supply Chain Formation: A Market Protocol and Competitive Equilibrium Analysis. *Journal of Artificial Intelligence Research*.
30. Fengfei, Z. (2009). Study on the Implementation of Green Supply Chain Management in Textile enterprises. *Journal of sustainable development*, 75-79.
31. Florida, R. (1996). Lean and Green: The move to Environmentally Conscious Manufacturing. *California management review*.
32. Fong, N.-J. C.-M. (2010). Green product quality, green corporate image, green customer satisfaction, and green customer loyalty. *African Journal of Business Management*, 2836-2844.
33. Foundation, I. B. (2011). *www.ibef.org.* Retrieved from Indian Brand Equity Foundation.
34. Gian Andrea Blengini, D. J. (2010). Green labels and sustainability reporting-Overview of the building products supply chain in Italy. *Management of Environmental Quality: An International Journal*, 477-493.
35. Grenaider, S. (n.d.). *Game Choices- The intersection of real options and Game Theory.*
36. Hamid, M. K. (2009). The Evolution Of Quality And Supplier Relationships. *International Review of Business Research Papers*, 90-97.
37. Handfield, R. S. (2005). Integrating Environmental Management and Supply Chain Strategies. *Business Strategy and the Envionment*.
38. Harland, C. M. (1996). Supply Chain Management : Relationships , Chains and Networks. *British Journal of Management*, S63-S80.
39. India., M. o. (n.d.). *Automotive mission plan 2006-2016, A mission for development of Indian Automobile Industry.*
40. Jamal, F. (2009). Green Supply Chain Management: A Literature Review. *Otago Management Graduate Review*, 51-59.
41. Jia Liu, N. L. (2011). The Construction of the Green Supply System based on Game Theory. *International Conference on Social Science and Humanity*, 341-346.
42. Joe Manget, C. R. (2009). *Capturing the Green for Consumer Companies.* BCG.
43. K.Srivastava, S. K. (2006). Managing product returns for reverse logistics. *International Journal of Physical Distribution & Logistics Management*, 524-546.

44. Ken Green, B. M. (1998). Green purchasing and supply policies: do they improve companies' environmental performance? *Supply Chain Management*, pp. pp. 89–95.
45. Khiewnavawongsa Sorraya, S. E. (2008). Green power to the supply chain.Proceedings of the annual meeting of the association of collegiate marketing educators., (pp. 244-249).
46. Kumar Venkat, W. W. (2006). Is Lean Necessarily Green? *Proceedings of the 50th Annual Meeting of the ISSS.*
47. Luthra Sunil, K. V. (2011). Barriers to implement green supply chain management in automobile industry using interpretive structural modeling technique-An Indian perspective. *Journal of industrial engineering and management*.
48. Mohanty, R. P. (1998). Managing green productivity: Some strategic directions. . *Production Planning & Control*, pp. 624-633.
49. Morelli, J. (2011). Environmental Sustainability:A Definition for Environmental Professionals. *Journal of Environmental Sustainability*, 19-27.
50. Motors, M. (2007-2012). *Mahindra Motors Sustainability Report.*
51. Motors, T. (2007-2012). *TATA Motors Sustainability Report.*
52. Nelson L. Nemerow, F. J. (2009). *Environmental Engineering: Environmental Health and Safety for Municipal Infrastructure, Land Use and Planning, and Industry.* John Wiley & Sons.
53. Orco. (2010). *How Game Theory Economics Explain Human Altruism*. Retrieved from Environmentalgraffiti.
54. P.Bhanu Krishna, K. K. (2012). The Importance of Transport and Logistics Services in Green Supply Chain Management. *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, 123-126.
55. Paul Hong, H.-B. K. (2009). Implementation of strategic green orientation in supply chain-An empirical study of manufacturing firms. *European Journal of Innovation Management*, 1460-1060.
56. Ramakrishnan.L. (2006). *Philips Green Manufacturing and Management in Electronics Industry.* Workshop on green manufacturing and management.
57. Ranjan Sanjeev, C. K. (2009). *Greening for future.* TCS ERU White paper.
58. Rao, P. (2002). Greening the Supply Chain:A new initiative in South East Asia. *International Journal of Operations and production Mgmt.*, 632-655.
59. Report, T. S. (2007-2012). *Toyota Sustainability Report.*
60. Richards, D. J. (1994). Environmentally Conscious Manufacturing. *World Class Design to Manufacture*, pp. 15-22.
61. Rugman, A. M. (1998). Corporate Strategies and Environmental Regulations: an Organizing Framework. *Strategic Management Journal*.
62. Samir, S. (2007). Green supply-chain management: A state-ofthe-art literature review. *International Journal of Management Reviews*, 53-71.
63. Sandeep Kumar, S. K. (2012). Green practices in Indian Automobile Supply chain: Factors important for implementation. *Journal of Information, knowledge and research in mechanical Engineering* , 156-162.
64. Sarkis, P. G. (2008). Environmental management system certification and its influence on corporate practices: Evidence from the automotive industry. *International Journal of Operations & Production Management*, pp.1021 - 1041.
65. Srivastava, S. K. (2007). Green supply-chain management: A state-of-the-art literature review. *International Journal of Management Reviews*, 53-80.
66. Suzuki, M. (2009-2012). *Sustainability Report.* Maruti Suzuki .
67. Tim Baines, S. B. (2012). Examining green production and its role within the competitive strategy of manufacturers. *Journal of Industrial Engineering and Management*, 53-87.

68. Vida, I. (n.d.). Determinants of Consumer Willingness to Purchase Non-Deceptive Counterfeit Products. *Managing Global Transitions*, pp. 253-270.
69. Vishal, N. D. (2012). An Overview of Green Supply Chain Management in India. *Research Journal of Recent Sciences*, 77-82.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE PERCEIVED KEY FACTORS OF PUBLIC E-SERVICE

Chien-I Weng, Graduate School of Information Management,
National Taiwan University of Science and Technology, Taiwan
Email: jwci@iii.org.tw

His-Peng Lu, National Taiwan University of Science and Technology, Taiwan

Kuang-Heng Shih, Chinese Culture University, Taiwan

Kai-ling Chen, Toko University, Taiwan
Email: chenkailing888@gmail.com

ABSTRACT

This article will assess who are the users of public e-service are and what their traits include, and then will further discuss what the perceived key factors that encourage people to use the public e-service. Lastly, what are the main factors to sustain the user to use the public e-service will be addressed as well. There have been many studies focus on e-commerce; however, very limited discussion tries to explore the e-service provided by the public sectors. Understanding the user traits and perceived key factors of public e-service through academic research plays a crucial role when government agencies confront obstacles of promoting e-government development.

The main study area of this article will separate into two parts – "user traits" and "perceived key factors of public e-service." Although they do not come out frequently in relation to the Technology Acceptance Model, "user traits" is one of the major factors that affect people's service usage behavior. This article will take comprehensive perspective, from service marketing theory, Technology Acceptance Model, and public administration perspective to collect related user traits. As a result, this article will choose the following five critical user traits for this study: Technology Readiness; Technology Anxiety; Interpersonal Interaction Need; Tendency of Engaging in Public Affairs; and Risk Perception.

For the perceived key factors of public e-service, the following areas will be discussed:

Internet Speed, Security, User Interface, Reliability, and Consumer Response. Below is the literature review of user traits and perceived key factors of public e-service.

Keywords: E-commerce, Public E-Service, E-Government

INTRODUCTION

One of the most remarkable and dramatic changes of ICT usage in recent decades has been the explosion of interest in the Internet, with the phenomenon of e-commerce becoming, in just a few years, a principal growth area in the worldwide economy. As the use of the Web by the private sector has increased, the public sector has followed closely behind, with all developed countries and almost all developing countries now having their own websites providing services and/or promoting their policies in real-time. More and more government agencies are using websites or portals in the same way as the private sector.The digital or electronic government is a contemporary trend in the globe, and the public servants around the world are also adopting novel ways to leverage information and communication technology (ICT) to better serve their constituents (Marchionini et al., 2003).

As these websites have been seen as the first step toward e-government, they are rapidly becoming a new aspect of government. Many citizens now have a brand new experience of contacting their governments online to communicate their opinions on current issues, request or submit an application, or petition an Act.

On one hand, most e-government initiatives are aimed at improving the efficiency of public administration through ICTs. On the other hand, such initiatives are also looking at ways to govern the public in an interactive way. In other words, engaging citizens in public affairs has been treated as a serious pursuit by government agencies, and the existing relationship between government and citizens is changing from the traditional one. This is also called "e-governance," as it tries to reinforce the connection between public officials and communities, thereby leading to a stronger and more accountable and inclusive democracy.

Since the rapid development of public e-service, it is now common for service providers such as government agencies to encourage people to use their new public e-service. According to a research done by the Development and Evaluation Commission of Taiwan (2012), the percentage of people searched government policy or announcement through the internet has increased from 35.7% to 52.6% during the year 2010 to 2011. Comparatively, the percentage

of using online application (through public e-service) on governmental websites has only increased from 23.9% to 31.3% during the same year. It is then evident that the percentage of people using public e-service had not been promoted effectively. From the point of view of service providers, in order to enlarge the usage number, it is important to know who the users of public e-service are how to distribute their usage experience to achieve multiplier effects.

1. User Traits

1.1 Technology Readiness and Technology anxiety

The concept of Technology Readiness is brought by Parasuraman. It can be analyzed from people's mentality and their overall status for discovering whether this person have the tendency of using new technology. Generally speaking, people who used to internet environment should have basic knowledge of computer and network. It can be seen as one who has a competency perspective and problem-solving capability. However, technology readiness is more focusing on natural psychology level rather than the acquired ability of people.

According to Parasuraman, there are four dimensions of Technology Readiness which are optimism, innovativeness, discomfort and insecurity (Parasuraman and Colby, 2003). These are used to analyze people's motivation and inhibitions of using technology, but not competency. Optimism is to view technology and belief in a positive way while increases control, flexibility, and efficiency for people's lives. Innovation is a trend for becoming a pioneer of technology and thought. Discomfort means the feeling of being overwhelmed or perceived lack of control over technology. Insecurity is the attitude of distrust and doubtful of their own technology capability. According to above description, optimism and innovation can be seen as the motivation of using technology. On the other hand, discomfort and insecurity are the inhibitors of technology （Parasuraman and Colby, 2001）. Hence, people who like to adopt new technology usually have high motivation while having low inhibitors.

The other concept is technology anxiety which is highly related to technology readiness. According to Meuter (1994), the definition of Computer anxiety is "the fear and apprehension felt by an individual when considering the implications of utilizing computer technology or when actually using computer technology." Moreover, the technology anxiety is not only focused on above mentioned Computer anxiety, but also focused on a people's state of mind

when they are using all kind of technology related tools. In compare with Technology anxiety, Technology readiness is specially emphasized on people's willingness and capability of technology usage in opposite position.

In fact, the state of mind plays an important role of whether users would accept new technology or not. People who recognize that the efficiency of new technology, when the discomfort has occurred, they will still avoid using it（Fang and Hsu, 2005）. Apart from state of mind, the population statistics variable will affect technology anxiety as well. In the study of Lee et al. (2010), he took retail's self-checkout system as an example and indicated sex, age, and income will affect technology anxiety remarkably.

Technology Acceptance Model (Davis, 1989) explains the attitude of people using technology and their behavior, which is derived from their perceived performance to technology and perceived ease of use. In fact, these two factors can affect people's innovation of using technology or so-called technology readiness. Citrin et al. (2000) pointed out that innovation in specific individual area will have an interference effect to technology tools usage, such as internet or online shopping. Furthermore, Dabholkar and Bagozzi (2002) found that the characteristic of inherent novelty seeking will attenuate people's perceived performance toward using technology tools.

In addition, Dabholkar and Bagozzi (2002) used the terms of "self-efficacy" to explain people's attitude of using technology for self-services. In general, customers with greater self-efficacy will have more confidence in their capability of technology usage. In this case, high self-efficacy is similar to low technology anxiety. Yi and Hwang (2003) pointed out that self-efficacy can be divided into "application-specific self-efficacy" and "computer self-efficacy," which will have a positive effect on ease of use and actual use of the system respectively. Meuter et al. (2003) explained technology anxiety level will affect one's experience of using technology. The lower the technology anxiety is, the higher the satisfaction toward technology-based self-services.

To summarize, technology readiness and technology anxiety are both intrinsic factors which describe the state of mind of users in the process of using technology. In compare with other extrinsic factors such as information access, information ability, and information literacy, these intrinsic factors can explain why citizens have different percentage of internet usage in same country. In other words, given the same level of technology access, users'

intrinsic factors would have greater influence than extrinsic one.

1.2 The Need of Interpersonal Interaction

Service encounter has been seen as a major factor that affects consumers perceived the level of service quality. It has been defined broadly as a period of time during which a consumer directly interacts with a service, which means the interaction between customer and service delivery system including service employees, facilities, and other tangible factors (Bitner, 1990). Hence, a loyal customer derived from direct interaction (such as face to face contact) with service employees has played an important role in terms of service marketing.

Dabholkar（1996）used the term "need for interaction with a service employee" to explain the situation. It was defined as the importance of human interaction to the consumer in service encounters, and this interaction in a service delivery is very important to some consumers （Bateson, 1985）. In addition, under the circumstance of using self-service technology such as the ATM machine, some of the customers will avoid using it due to their tendency of needing interaction with service employees. Hence, tendency of interpersonal interaction need will affect customer's perceived ease of use attitude of using technology-based self-service（Dabholkar and Bagozzi, 2002）. Moreover, the need of interpersonal interaction will also related to some population statistic variables, such as sex and age. Generally speaking, female tend to use self-service technology with more interactive information, and at the same time looking for assistance from service employees（Burke, 2002）. As mentioned, customers with higher tendency of interpersonal interaction need, he or she will likely to avoid using any self-services machines. It is because they want to interact with employees directly. Hence, for those who with higher tendency interpersonal interaction need, providing a usage introduction of self-service machine by service employees can enhance customers' perceived of using service.

1.3 Tendency of Engaging in Public Affairs

Depending on the different research fields, tendency of engaging in public affairs (or so-call Civic engagement) has various definitions. It refers to the ways in which citizens participate in the life of a community in order to improve conditions for others or to help shape the community's future (Adler and Goggin, 2005). In "Bowling Alone," a famous book written by Putnam, he indicated that civic engagement is a basic foundation for building "Social

Capital". The form of civic engagement includes official and unofficial social activities. The former includes visiting friends, and playing poker with friends, while the latter is to engage in community service and political engagement (Putnam, 2001).

Regarding the interactive effect between technology usage and people's tendency of engaging in public affairs, it turns out to be an ambiguous relationship due to the limitation of methodology and observation of raw data（Norris, 2001）. The existing studies provide explanation of the relationship between two perspectives. One is Optimism and the other one is Pessimism or Skepticism. Norris (2001) indicated mobilization and reinforcement hypotheses based on skepticism. Mobilization hypotheses considered that the technology is able to encourage majority of people to involve in public affairs, whereas reinforcement one believed that technology will enlarge the digital divide because only those who have the power to access the information through technology will dominate the resource. As a result, Carpini's research (2000) also indicated that technology can increase the civic engagement for those who are interested in public affairs, or has involved in public affairs, however, to those who are not interested in public affairs, the technology is somehow useless or ineffective. In general, most of the researchers agree that technology causes the reinforcement effect rather than mobilization effect toward the civic engagement. For those who had already highly engaging in real world will enlarge their experience to virtual world with using technology. According to Norris's (2001) reinforcement hypotheses, people who have engaged in public affairs will tend to use public e-service and generate positive result.

1.4 Risk Perception

Risk perception is the subjective judgment that people make about the characteristics and severity of a risk. It referred to the feeling of uncertainty regarding possible negative consequences of using a product or service (Featherman and Pavlou, 2003). A formal definition is a combination of uncertainty plus seriousness of outcome involved and the expectation of losses associated with purchase and acts as an inhibitor to purchase or using behavior (cited from Featherman and Pavlou, 2003). In addition, risk perception can be viewed as a substitution behavior consequence（Featherman and Pavlou，2003）. For example, purchasing luxury can increase financial risk but reduce social risk. Under the background of public e-service or technology based self-service, there are many courses discussing about psycho-social and performance risk, as well as new subjects such as privacy risk（Featherman and Pavlou，2003）.

In addition, Dabholkar and Bagozzi（2002）referred social risk to explain the concept of "self-consciousness" in terms of using technology service. Self-consciousness will affect the outcome of perceived feeling. Their study pointed out an interesting result that if a person has higher self-consciousness, which is also higher social perceived risk, he or she will hesitate to use technology based self-service. In other word, high social perceived risk could be the reason that people are unwilling to use technology. The same result was also pointed out by Bateson's research (1985).

2. Perceived Key Factors of Public E-Service

2.1 Internet Speed, Security, and User Interface

Internet speed has been the major factor of whether the public e-service can be accepted by customers as a convenient tool. Since the rapid development of information and communication technology, Internet speed level is gradually increasing. However, whether faster Internet speed enhancing customers' willingness of public e-service usage remains as an unsolved issue. In fact, increasing Internet speed level does not mean that customers are willing to use the public e-service, the satisfaction toward Internet speed most depends on personal subjective feeling. Nevertheless, the interactive relationship between Internet speed and customers is an important issue for many scholars because few studies discussed the connection between Internet speed and customers' satisfaction (Fillion and Ekionea, 2010). In addition, it is important to construct a reliable research methodology for connecting Internet speed and customers' satisfaction effectively. According to the study of Fillion and Ekionea (2010), Internet speed plays a critical role in customer's satisfaction level. Moreover, Alpert (2008) had pointed out that Internet speed is the major factor that customers are willing to choose technology based self-service.

Security is a major factor that has great influence on customers' public e-service usage as well. Alpert (2008) indicated that the biggest reason of customers using self-service system is because they can have multiple ways to finish the transaction with high protection of privacy and easy to use. Among the reasons, privacy protection can be taken as one dimension of security. In general, although the level of security depends on which technology in used and the understanding toward technology, nevertheless; most of customers do not really want to spend too much time nor having required knowledge, such as fire wall or password verification setting (Rosada el at 2006). Hence, the only thing that customers concern in

terms of security issue is whether the public e-service provided full protection. In terms of the level or the type of protection is not in customers' consideration. Furthermore, customers' will ask public e-service providers take full responsibility of customers' security issue. If the public e-service providers failed customers' expectation, it will affect their satisfaction and willingness toward the service usage considerable.

Since the user interface is the first thing that customers encounter when using public e-service, it is another important perceived key factors of public e-service and also representing an critical intermediary role between customers and the service. Fjeld and Barendregt (2009) indicated that a good user interface should include high efficiency, high effectiveness, and high satisfaction. Zuehlke and Thiels (2008) have similar conclusion. In brief, a good user interface can encourage customers to use public e-service, and can bring higher effectiveness and feedback for the service. Furthermore, it will help to increase customer's willingness of public e-service usage as well.

2.2 Reliability and Respond

If public e-service's reliability cannot be validated by customers, they will reduce their willingness to use the service, and the service will be less likely to have high satisfaction indeed. No matter which service is purchased by customers, the reliability of service is always on the top of customers' list (Hensley and Utley 2011).In addition, Hensley and Utley (2011) pointed out with a technology tool that can increase service's reliability, and it can also enhance customers' understanding and usage tendency toward the service. Furthermore, it will strengthen the trustful relationship between customers and the service.

Consumer Response is another concept for discussing this issue.– The definition of consumer response is after customers using the service, they will give response accordingly. In addition, Pauwels (2004) pointed out the level of consumer response depends on products and the content of the service, and the major decisive factor that makes the difference is derived from the service providers. Hence, consumer response is an interactive relationship between service providers and services users, which whenever one's action will cause its counterpart to respond accordingly, and vice versa. Svensson (2002) mentioned the origin of the consumer response is designed as a research pattern which explains interaction between service providers and customers. Furthermore, a good consumer response can be viewed as customers accept the service and are willing to keep using the service.

Although there are many articles discussed about user traits and perceived key factors of public e-service, we still do not know whether these factors have anything to do with the public e-service usage. It would be useful for government's public e-service promotion if we can find out which perceived key factors plays more important role in the issue of public e-service usage. Furthermore, the research result will also help to increase the customers' willingness to use the public e-service, and to increase the satisfaction toward the service.

METHODOLOGY AND ANALYSIS

Based on literature review above, this study's research frame is as follow:

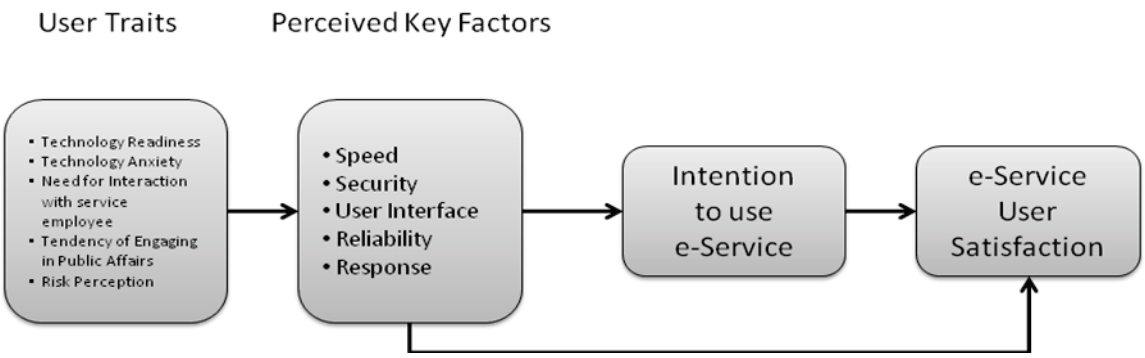


Figure 1 Research structure of the study

Many previous studies that have adopted a user-centric approach to e-government are concerned with how to provide a more convenient and continuous service to users from a system perspective. However, there is no research that explores the intrinsic characteristics and their effects on public e-services. This study tries to look into this important individual variance in terms of user traits in order to gain insight into the current user's profile, by discussing user traits and the perceived key factors of the e-service, and by examining the causality. Meanwhile, unlike previous studies that discuss from a single perspective, such as information system or service marketing, this study employs a multi-faceted analytical method by integrating different kinds of theories and perspectives. From a multi-faceted literature review, the major intrinsic determinants, such as computer self-efficacy, technology readiness, anxiety, risk perception, human contact and engagement experience, which might be influential toward the user's perceived key factors of a public e-service.

The relationship between user traits and perceived key factors has been discussed in the literature review section above. People with various characters will have different perceived

key factors toward public e-service and will have influence on the "intention to use" and user's "satisfaction". Taking technology anxiety as an example, personal character of technology anxiety will have great impact on the perceived key factors of public e-service, including Internet speed, security, user interface, reliability, and consumer response. In terms of the relationship between perceived key factors and "intention to use", it can be explained by the relationship between behavior and intention from the Technology Acceptance Model (TAM). Within TAM, the perceived usefulness and perceived ease of use has great impact on usage behavior. In this article, perceived key factors of internet speed, security, user interface, reliability, and consumer response has same effect on "intention to use" like perceived usefulness and perceived ease of use from TAM.

To verify the factors in this study, a survey was conducted by a statistic methodology called Partrial Least Squares (PLS), in order to analyze the data. The survey had been conducted for two weeks and the targeted respondents focused on the user who had used public e-service online. –We had collected 228 questionnaires while four of them were invalid so the total number of valid questionnaires is 224. The original questionnaire comes from past related article and its content is validity. Before acquiring raw data and conducting the PLS analysis, it should conduct factors analysis first for selecting the question properly. Because the original questionnaire contains over 60 questions, so it needs to take off some of the irrelevant questions for the research. –In addition, to avoid second-order problem, it have to have factor's score to represent the original factors or potential variable.– The original questionnaire include 62 questions, verify in 4 dimensions, and 15 factors. After the factor analysis, 25 questions was abandoned due to their scores was lower 0.7. –The remaining 37 questions are highly relevant to verify the dimensions, including Discomfort, Insecurity, and Innovation from technology readiness, technology anxiety, interpersonal interaction need, risk perception, and tendency of engaging in public affairs; security and consumer response of perceived key factors; public e-service intention to use and user's satisfaction.

In terms of the reliability and validity of this study, almost all dimensions' composite reliability is higher than standard 0.7 except technology readiness (0.679748) and perceived key factors of public e-service (0.665302). Regarding the validity, most of potential average variance extracted (AVE) is higher than 0.5, only technology readiness (0.424) is lower than the standard 0.5.The standard level of the whole model can be observed from communality. In general, all of the communality of the dimensions is higher than 0.3, which means the model constructed by this study is fit with the standard level.

After conducting the path analysis on all dimensions for understanding the relationship between each dimension, the result is showed in figure 2. According to the result we have, the user traits to the perceived key factors of public e-service, including interpersonal interaction need, technology anxiety, and risk perception, reaches significant level, and their path coefficients are 0.4987, 0.2838, and 0.2994. As the result, we can conclude that the user with higher interpersonal interaction need, technology anxiety, and risk perception will have higher perceived and need on security and consumer response of perceived key factors.

In addition, users' perceived key factors of public e-service is significant at "intention to use" （0.1396, $p<0.05$）.Meanwhile, users' perceived key factors of public e-service is significant at user satisfaction of public e-service（0.642, $p<0.01$）. In other word, selected two perceived key factors from this study, the security and consumer response, has impact on "intention to use" and "satisfaction" respectively. The two perceived key factors, security and consumer response, are highly influencing the satisfaction of usage in terms of e-service. It means the perceived key factors in this study are critical toward user's satisfaction. However, the relationship between perceived key factors and "intention to use" is relatively weak. "Intention to use" needs other antecedents to give more explanation power in this model. Taylor and Todd (1995) considered that other mediators like attitude, subjective norms and perceived behavior control should existed between perceived key factors and behavior intention, and the model is named "Combined TAM and TPB Model". Though this study did not mention these antecedents, it still offers a meaningful direction for the further research.

Finally, we can know from the path analysis that interpersonal interaction need and technology anxiety has significant indirect effect on "intention to use" and "satisfaction". In other word, interpersonal interaction need and technology anxiety in the model are two critical user traits. These two user traits will have considerable influence on the "intention to use" and "satisfaction" of public e-service.

Table1. Reliability and validity of this research

Dimensions	Composite Reliability	AVE	Communality
	>0.7	>0.5	>0.3
Technology Readiness	0.679748	0.424	0.424375
Technology Anxiety	0.933982	0.78	0.779854
Interpersonal Interaction Need	0.84625	0.651	0.650665
Risk Perception	0.927943	0.811	0.811482
Tendency of Engaging in Public Affairs	0.916177	0.785	0.785199
Perceived Key Factors	0.665302	0.5	0.5
Intention to Use	0.8783	0.644	0.643966
Satisfaction	0.92883	0.813	0.813182

Figure2 Result of Path Analysis

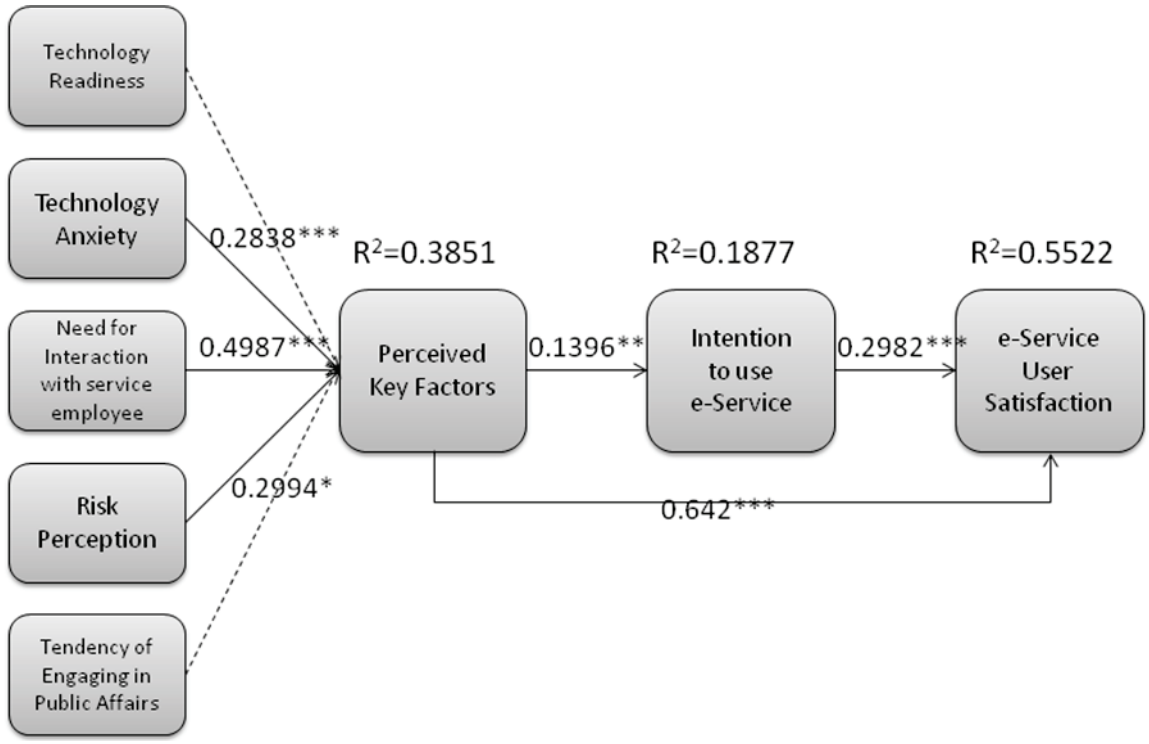


Table 2 Path analysis and statistics

Constructs	Perceive key factors of public e-service	Intention to use of public e-service		User's satisfaction of public e-service	
	Direct	Total	Direct	Total	Direct
Interpersonal interaction need	0.498741*** (8.922018)	0.069630* (1.555993)		0.498741*** (6.802200)	
Tendency of engaging in public affairs					
Technology readiness					
Technology anxiety	0.283787*** (3.182351)	0.039620* (1.591403)		0.194001*** (3.145525)	
Risk perception	0.299427* (1.357773)				
Intention to use of public e-service				0.298221*** (6.325107)	0.298221*** (6.325107)
Perceived key factors of public e-service			0.139611** (1.674042)	0.683614*** (15.915843)	0.641980*** (16.547857)

Notes: Values in parentheses are t values, *P<0.1, **P<0.05, ***P<0.01

CONCLUSION

From analysis result of the survey, we can find out the relationship between user traits and perceived key factors of public e-service are relevant, of which especially the technology anxiety, interpersonal interaction need, and risk perception are significant relevant. From the articles discussed technology anxiety, need for interaction with service employee, and risk perception, people may have intrinsic concern because for one thing customers don't understand the technology, another is because they used to interact with service employee directly, still another is because they feel about risk will come along with public e-service usage. All of these will result in low public e-service usage and affect their intention to use and user satisfaction. In addition, user traits are intrinsic factors of customers, and the starting point of deciding whether customers are willing to use public e-service. The starting point will affect extrinsic factors such as perceived key factors of public e-service, and will affect the usage willingness and the level of usage.

For those governments who provide public e-service, it is an important to consider user traits and perceived key factors while constructing public e-service and promoting the usage willingness. The government's public e-service usually doesn't have the image of good quality service.Hence, public e-service cannot have positive impact on government's public image and may produce obstacles on its policy promotion. From the point of view of policy marketing, because most of the services are taken as public good, hence it will not target customers like business marketing does (Snavely, 1991).Nevertheless, the government and other related departments still need to find out who are the users. Snavely (1991) indicated that the core of the policy marketing pattern is targeted customers which they are existed indeed. Through the analysis of this study, we can know who the users of public e-service are and what perceived key factors that they care the most, and use these research results to improve public e-service quality.

Public e-service is one of the most convenient tools of information communication.However, if the advantage of public e-service cannot be developed completely, there will be no actual outcome even with mass resource investment. If governments take user traits, including technology anxiety, interpersonal interaction need, and risk perception, and perceived key factors into consideration while providing public e-service, it will promote intention to use and user satisfaction effectively.

Understanding user traits will help us to know who are the targeted users firstly and start to plan marketing strategy of public e-service.According to Roger's (1995) diffusion of innovations theory, new technology will only be adopted by Innovators in the beginning, then spread their usage experience to other early adopters, early majority, later majority, and laggards. Hence, the promotion of public e-service needs to know who is its targeted users and defines them as innovators and through the distributing of innovators' usage experience to the public. We will have higher public e-service usage percentage effectively and efficiently.

RESEARCH RESTRICTION AND FUTURE RESEARCH DIRECTION

First, the respondents of the survey have the experience of public e-service usage in Taiwan and it was not restricted in any specific e-service area. However, due to the wide range of public e-service, it includes personal online application, information search, and governmental public procurement bid are all public e-service. In general, different services will have various perceived key factors and user traits. –It is a future task to conduct further study on specific public e-service for understanding the relationship of their user traits and perceived key factor.

Second, although this study is conducted through PLS analysis and it is possible to do further analysis of factors' relationship, the relationship among samples cannot provide any further analysis result.Because user traits are the key of this study as well, if adopted other statistics analysis, we can categorize those user traits and perceived key factors of public e-service. It will help the actual policy plan significantly. Moreover it is possible to use other research analysis with the existing raw data to have a more adequate analysis.

REFERENCE

1. Fang, S.R. and Hsu, C.P., (2005), "The Impacts of Technology-Based and Interpersonal-Based Service Encounter on Relationship Benefits", *Management Review*, Vol. 24, No. 2, pp.53-76
2. Adler, R.P. and Goggin, J., (2005), "What do we mean by "Civic engagement?", *Journal of Transformative Education*, Vol. 3, No. 3, pp.236-253
3. Alpert, H.K., (2008), "The self-service 'buy–and-pay' market: kiosk, vending and foodservice trends in the US", available at: http://academic.marketresearch .com/

(accessed September 11, 2012)

4. Bateson, J. E. G., (1985), "Self-Service Consumer: An Exploratory Study", *Journal of Retailing*, Vol. 61, No. 3, pp.49-75
5. Bitner, M. J. Booms, B. H. and Tetreault, M. S., (1990), "The Service Encounter:
6. Burke, R.R., (2002), "Technology and the customer interface: what consumer want in the physical and virtual store", *Journal of the Academy of Marketing Science*, Vol. 30, No. 4, pp.411-32
7. Diagnosing Favorable and Unfavorable Incidents", *Journal of Marketing*, Vol. 54, No. 1, pp.71-84
8. Citrin, A. V., Sprott, D. E., Silverman, S. N. and Stem Jr, D. E., (2000), "Adoption of Internet Shopping: the Role of Consumer Innovativeness" *Industrial Management & Data Systems*, Vol.100, No.7, pp.294-301
9. Dabholkar P., (1996), "Consumer evaluations of new technology-based self-service options: An investigation of alternative models of service quality", *International Journal of Research in Marketing*, Vol.13, No. 1, pp.29-51
10. Dabholkar, P. A. and Bagozzi, R. P., (2002), "An Attitudinal Model of Technology-Based Self-Service: Moderating Effects of Consumer Traits and Situational Factors", *Journal of the Academy of Marketing Science*, Vol. 30, No.3, pp.184-201
11. Davis, F. D., (1989), "Perceived usefulness, perceived PEOU, and user acceptance of information technology", *MIS Quarterly*, Vol.13, No. 3, pp.319
12. Featherman, M. S. and Pavlou, P. A., (2003), "Predicting e-services adoption: a perveived risk facets perspective", *International Journal of Human-Computer Studies*, Vol.59, pp.451-474
13. Fillion, Gérard and Jean-Pierre Booto Ekionea, (2010), "Testing a moderator-Type Research Model on the Use of High Speed Internet" *Proceedings of the Academy of Information and Management Sciences*, Volume 14, Number 2
14. Fjeld, Morten and Wolmet Barendregt, (2009), "Epistemic action: A measure for cognitive support in tangible user interfaces?" *Behavior Research Methods,* 41 (3)
15. Habermas, J., (1996), "Between Facts and Norms: Contributions to a Discourse Theory of Law and Democracy", Cambridge, MA: MIT Press
16. Hensley, Rhonda L. and Joanne S. Utley, (2011), "Using reliability tools in service operations", *International Journal of Quality &Reliability Management,* Vol.28, No.5, pp.587-598
17. Lee, H.J., Cho, H.J., Xu, W.W and Fairhurst, A., (2010), "The influence of consumer traits and demographics on intention to use retail self-service checkouts", *Marketing*

Intelligence & Planning, Vol. 28, Iss:1, pp. 46-58

18. Meuter, M. L. Ostrom, A. L. Bitner, M. J. and Roundtree, R., (2003), "The influence of technology anxiety on consumer use and experiences with self-service technologies", *Journal of Business Research*, Vol. 56, pp.899-906
19. Marchionini, G., Samet, H. and Brand, L., (2003), "Digital Government", *Communications of the ACM*, Vol.46, No.1, pp.25-27
20. Norris, P., (2001), "Digital Divide: Civic engagement, information poverty, and the Internet Worldwide", *Cambridge University Press*
21. Parasuraman, A., (2000), "Technology Readiness Index (TRI): A Multiple-Item Scale to Measure Readiness to Embrace New Technologies", *Journal of Service Research*, Vol. 2. No. 4, pp.307-320
22. Parasuraman, A. and Colby, C. L., (2001), "Techno-ready marketing: how and why your customers adapt technology", *New York, NY: The free press*
23. Parasuraman, A. and Colby, C. L., (2003), "Technology Still Matters", *Marketing Management Magazine*
24. Pauwels, Koen (2004), "How Dynamic Consumer Response, Competitor Response, Company Support, and Company Inertia Shape Long-Term Marketing Effectiveness", *Marketing Science*, Vol.23, No.4, Fall, pp.596-610
25. Putnam, R. D., (2001), "Bowling Alone: the collapse and Revival of American Community", *New York: Simon & Schuster*
26. Rogers, E.M., (1995), "*Diffusion of innovation (4th Ed.)*," NY: The Free Press
27. Rosado, David G., Carlos Gutie´rrez, Eduardo Ferna´ndez-Medina and Mario Piattini, (2006), "Security patterns and requirements for internet-based applications", *Internet Research*, Vol. 16 No. 5, 2006 pp. 519-536
28. Snavely, K., (1991), "Marketing in Government Sector: A Public Policy Model," *American Review of Public Administration*, Vol.21, No.4, pp.311-26
29. Svensson, Goran (2002), "Efficient Consumber Response- Its Origin and Evolution in the History of Marketing", *Management Decision*, 40,6, pp.508-519
30. Taylor, S., and Todd, P.A., (1995), "Understanding Information Technology Usage: A Test of Competing Models", *Information Systems Research*, Vol.6, No.2, pp. 144-76
31. Yi, M. Y. and Hwang, Y., (2003), "Predicting the use of web-based information systems: self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model", *International Journal of Human-Computer Studies*, Vol. 59, pp.431-449
32. Zuehlke, Detlef and Nancy Thiels, (2008), "Useware engineering: a methodology for the development of user-friendly interfaces", *Library Hi Tech*, Vol. 26 No. 1, pp. 126-140

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

THE RELATIONSHIPS AMONG GREEN OPERATIONS, GREEN INNOVATION, AND ENVIRONMENTAL PERFORMANCE

**Rong-Huei Chen, Department of Business Administration,
Lunghwa University of Science and Technology, Taiwan
Email: ronghuei@mail.lhu.edu.tw**

**Ru-Jen Lin, Department of Business Administration,
Lunghwa University of Science and Technology, Taiwan**

**Yen-Ju Lin, Department of Business Administration,
Lunghwa University of Science and Technology, Taiwan**

ABSTRACT

Purpose *– The purpose of this study is to investigate the relationships among green operations, green innovation, and environmental performance.*
Design/methodology/approach *– Data from 141 Taiwan high-tech manufacturers are collected. SEM analysis is employed to examine the relationships among green operations, green innovation, and environmental performance.*
Findings *– This study finds that Taiwan high-tech manufacturers perform various levels of green operations and, consequently, display different levels of effects on green innovation and environmental performance. In addition, positive relationships were found between green operations and green innovation and environmental performance (i.e. environmental operational performance, environmental managerial performance) and between green innovation and environmental performance.*
Practical implications *–By putting forward that the integrating of green operations and green innovation affects organizational environmental performance more positively than the sole impact of green operations on organizational environmental performance, this study has suggested manufacturers should pay more attention to develop related strategies to cope with customer demand, thus achieve better customer satisfaction and sustainable operation.*
Originality/value *– In the context that green issues are currently the novel theme for research and have attracted increasing attention from managers but there remains the lack of empirical studies among green operations, green innovation, and environmental performance, this study has contributed to the extant literature with the model combining these aspects. As such, the research findings have provided helpful academic references and managerial guidelines for firms in gaining competitive environmental performance.*

Keywords: Green Operations, Green Innovation, Environmental Performance
Paper type: Research paper

INTRODUCTION

The rapid economic growth worldwide and constantly changing advanced technologies have placed tremendous burderns on the earth's ecosystems and limited natural resources. In recent years, due to an increased environmental awareness and a goal of sustainable manufacturing, many national governments have introduced laws to reduce unnecessary environmental harm and to regulate green products, such as Waste Electrical and Electronic Equipment (WEEE) and the Restriction of Hazardous Substance (RoHS). Such these directives have strongly enforced manufacturers to focus more on green production or else lose their competitiveness. As a result, green operations have been increasingly attracting more attention and discussions worldwide. Concerning Taiwan context, since this country acts as one of the world largest export-oriented electronic OEM and ODE and has close relationships with the European Union (EU), the United States of America (USA), and Japan, environmental issues cannot be ignored due to their dramatic effects on indistries' financial performance. Hence, in order to achieve sustainable competitiveness and customer satisfaction and market leadership, Taiwanese manufacturers need to pay more attention to environmental legislation during manufacturing processes and the development of green operational models.

Green operational management refers to the close cooperatation between up-stream and down-stream manufacturers to reduce environmental damage and to use "green" as a prerequisite to extend Supply Chain Management (SCM) issues. In addition to the original emphases of SCM on cost, flexibility, speed, and quality, green operational management adds environmental criteria into raw-materials purchasing, packaging, design, manufacturing, reuse and recycling for achieving energy-conservation, emission-reduction and promoting overall environmental quality. It also takes a holistic operational model into practice and meets legislative requirements. The final goals will be improved environmental performance, increased product values, and environmental impact reduction.

Current industries worldwide are facing tremendous enforcement for the implementation of green concept into products and services, thus they have started to ask suppliers and customers to pay more attention to environmental issues. In this context, innovative product processes will effectively help solve operational and administrative burdens through reducing negative environment impact. A review on the extant literature shows that there have been numerous studies on SCM and organizational performance (Zhu and Sarkis, 2004; Hervani et al., 2005; Chien and Shih, 2007); simultaneously, green innovation has become one of critical research issues (Rao and Hult, 2005; Qi et al., 2010). Nonetheless, missing in literature is studies investigating whether the launching of green operations would affect green innovation and organizational environmental performance. Hence, this study aims at the impact of green operations on green innovation and organizational environmental performance. The achieved findings provide useful references for the industry and experts with green operations implementation and environmental protection.

LITERATURE REVIEWS AND RESEARCH HYPOTHESIS

1. Green Operations

Green operations have been lauded as an effective approach to enhance sustainability programs and to open up the distribution channel from manufacturers to suppliers (Cooper and Ellram, 1993; Van Weele, 2002). Recently, since firms worldwide have been strongly affected by shortened product life cycles and increasing amount of waste caused by the expansion of high-tech industries, firms have paid more attention to environmental protection and the search for effective GSCM (Geyer and Jackson, 2004; Hanna and Newman, 1995), aiming to better manage raw material purchasing, enhance product recycle, reuse, and remanufacture as well as economic green packaging, thus provides businesses with numerous opportunities to achieve more sustainable competitiveness and environmental damage reduction (Green et al., 1996; Narasimhan and Carter, 1998).

Green operations put environmental protection into the management system by taking "green" notions into the supply chain (Winn and Roome, 1993). Hence, through taking internal organizational practices and external relationships with suppliers into deeper consideration, green operations have been widely perceived to be closely associated with product design, raw material purchasing, product manufacturing, recycle control, and effective reduction of hazardous materials (Sarkis, 2003). In other words, green operations are an operational process from up-stream suppliers and manufacturers to down-stream customers by mutural cooperatation.

In the extant literature, the concept of green operations covers a wide range of aspects due to the existence of various GSCM practices. Due to the focus on exploring internal operationsal management process, this study defines this process as "green operations" (Zhang and Li, 2009). Frentzel and Sease (1996) refers to the ideal green operations is that each indurtry devotes to enhance cooperative relationships among employees through information sharing since this endeavor can expand green operations to the ultimate attainment.

To summarize, green operations include green design, green production, green marketing, and reverse logistics (Bhamra, 2004; Peattie, 1992; Hervani et al. 2005). Green design refers to the design of products that emphatically consider the environement impact of raw resources during the entire product life cycle through deeper focuses on product function, quality, and cost to proceed to superior quality. In other words, green design reviews product life cycle from sustainsuable angles and directly imports 3R (reduce, reuse, recycling) into the product development stage for reducing negative environmental impact (Gupta, 1995). Chen et al. (2006) regards green marketing as arousing industrial intuitive ability to reduce harmful environment factors and produce green product, to plan recycle, reuse, and renew system, establish environment-oriented and public welfare image. Drawing the blueprint of sustainable development pattern, green marketing can conduct consummers into green consumption mainstream, and promote industrial competitiveness. Fleischmann et al. (1997) defines reverse logistics as the process of transforming used products into re-usable products. Hervani et al. (2005) propose that reverse logistics differ from traditional logistics through condersidering cost and recycle value of products and components at the lowest cost to conduct the higest reuse

value.

2. Green Innovation

Green innovation is defined as organizations' implementation and introduction of new ideas, products and processes which contribute to environmental impact reduction or to specified eco-targets (Klemmer et al., 1999; Rennings, 2000; Chen, 2008; Oltra and Saint Jean, 2009). It is further involved with energy-saving, pollution prevention, waste recycling, green product designs, and corporate environmental management (Chen et al., 2006).

This study investigates environmental issues in Taiwan since Taiwanese firms have conducted green issues and most of them are OEM organizations, thus they have to meet the regulations from downstream customers. This study adopts the idea of Klemmer et al. (1999), Rennings (2000), Chen (2008), and Oltra and Saint Jean (2009) that green innovation is consisted of green product innovation, green process innovation, and green administrative innovation. Green product innovation is defined to be product innovation which is closely associated with environmental concerns (i.e. energy saving, pollution prevention, waste recycling, no toxicity, and green product designs) (Chen et al., 2006). In other words, green product innovation is viewed as a means of reducing environmental impacts during green products' entire life cycle by reducing toxics and materials used, controlling power consumption and emission release, and extending the use phase in term of recyclability (Kammerer, 2009). Green process innovation refers to the modification of the current operating processes and systems, aiming to produce new or significantly improved green products which can reduce environmental impact (Meeus and Edquist, 2006). Birkinshaw et al. (2008) refer green administrative innovations to the update of organizations' management practices using a new and eco method, thus leads to environmental impact reduction.

3. Environmental Operational Performance and Environmental Managerial Performance

According to ISO14030, orginizatinal environmental performance refers to a systematic procedure of measuring and assessing environmental performance on industry. Accordingly, ISO 14031 defines environemtal Environmental Performance Indicators (EPIs) to include Operational Performance Indicators (OPIs) and Management Performance Indicators (MPIs). Environmental operational performance reflects environmental performance on the process of operations, such as import raw material, engery, and service. It belongs to organizational facilities' hardware and design, install, operation, and maintance and the output during operational process (e.g. product, service, waste, emission (Papadopoulos and Giama, 2007). Environmental managerial performance reflects the efforts of management echelon on improving environmental operational performance. It benefits management efficiency evaluation and improving environmental performance dicesion-making and motivation (Chien and Shih, 2007). For instance, managerial performance and orginizational stratum policy, members, legislative activities, measures, procudures, decision can provide and improve the capabilities and efforts on business aspects, such as the modified measures of training, legislative demand, resource usage, environmental cost management, purchase, product R&D, and electronic-document which can affect environmental performance.

In sum, in this study, organizational environmental performance is reffered to as performance assessment focusing on environment. Hence, this study adopts Papadopoulos and Giama (2007) and Chien and Shih (2007)'s ideas to divide environmental performance into environmental operational performance and environmental managerial performance. Environmental operational performance refers to measure performance of energy and resource usage, reduce air, water, toxic waste, CO_2 emission. Environmental managerial performance points to measure improving the relationship between manufacturers and communities, and promoting industrial image.

4. Hypotheses Development

4.1 Green Operations and Green Innovation

Shrivastava (1995) points out the integration of enivironmental protection concepts into design build up the concepts for green product design, which in turn reinforences green product innovation. The main aim of green product innovation is to minimize environmental harm through green production. In support, Marcus (2007) indicates that firms' engagement in green production and green marketing will positivily affect their green manufacturing innovation and green administrative innovation. Concerning green administration innovation, Winn and Roome (1993) propose that of industry should expand this concept to the whole supply chain management and throughout green marketing to promote industrial green image and administrative innovation. As such, green marketing will bring about greater demands to customers; that is to say, green marketing has a positive impact on green product innovation (Belz and Bilharz, 2005).

In response to environmental pressures, industries need to implement green marketing to better reinforence green administrative innovation and promptly solve environmental protection problems. It is also noted that green marketing positively reinforces green administrative innovation (Newman and Breeden, 1992; Peattie, 1992; Marcus, 2007). As a result, this study establishes the first hypothesis as follows:

H1 - Green operations have a positive impact on green innovation.

4.2 Green Innovation and Environmental Performance

Porter (1991) proposes that pressures from regulation, cost reduction, and the need for environmental operational performance improvement have strongly enforced industries to develop green innovation through green product innovation, green manufacturing innovation, and green adminnistrive innovation. In addition to meet the requirement of regulation, it can reduce cost and improve. In addition, Geffen and Rothenberg (2000) point out that green product innovation, green manufacturing innovation, and green administrative innovation are the main sources of improving enivornmental operational performance. Specifically, green product innovation helps firm meet regulation requirements, promote effective resource application and industrial image (Rosa and Pierpaolo, 2010) as well as reduce different environmental problems during product life cycle through minimizing toxic material and electric comsumption (Kammerer, 2009). In other words, green product innovation has a positive impact on

environmental operational performance on each stage throughout product life cyle. In addition, green manufacturing innovation has been widely perceived as an effective means for firms in improving environmental operational performance through cleaner production, green manufacturing processes, and waste reduction (Klassen and McLaughlin, 1996), thus facilitate firms to achieve unique competitiveness and promote environmental operational performance (Edeltraud and Lilly, 2006). In line with this, Tao (2009) claims that green manufacturing innovation effectively decreases gas emission and increases energy utility rate in petrochemistry industry. Finally, Chen et al. (2006) and Shrivastava (1995) address green administrative development as a tool to help firms increase competitive benefits, reduce cost, enhance product and manufacturing innovation, increase industrial image, and promote environmental managerial performance. It is also noted that green managerial innovation positively influences envrironmental managerial performance (Kim and Srivastava, 1998). Therefore, this study proposes the following hypotheses:

H2 - Green innovation has a positive impact on environmental operational performance.

H3 - Green innovation has a positive impact on environmental managerial performance.

4.3 Green Operations and Environmental Performance

Steger (1993) propose that green operations can help firms save cost, increase market opportunity, promote usable resource efficiency, and prevent pollution which would benefits industry with better regulation compliance, higher employee motivation and effective organization, lower risk and environmental responsibility and information flow distribution. Schoell and Guiltinan (1993) indicate green marketing enhances organizational environmental image. Taylor (1992) suggests that green environmental management emphizes the adoption of positive and active attitude in order to better response to possible problems during marketing processes. It has been also widely perceived that industries which implement green environmental management and green innovation can efficiently promote environmental operational performance, reduce cost, achieve more effective environmental protection that help firms avoid the expense of environmental dispute, environmental accident, environmental ban, and the loss from customer boycott (Taylor, 1992). Moreover, Ken and Martin (2007) address that green marketing mainly focuses on minimizing negative environmental impact throughout product life cycle, implying its positive impact on environmental operational performance.

The main purpose of green operations is to manufacture green products that are closely associated to practices of renew, recycling, reuse, and resuseable disposal in the end of product life. That is to say, green products can facilitate the reduction of materials, waste, and pollution emission as well as the enhancement of resource application. Chien and Shih (2007) find that green production positively influences environmental operational and managerial performance. Tsoulfas and Pappis (2006) address that the reuse of materials can considerably save internal cost, exploit new market, and achieve competitive advantage. Theyel (2001) and Rao and Holt (2005) propose that once taking green recycle and reuse into practice, industries can effectively save material, water, and energy, thus improve oginizational environmental performance. As a result, this study establishes the following hypotheses:

H4 - Green operations have a positive impact on environmental operational performance.

H5 - Green operations have a positive impact on environmental managerial performance.

Figure 1 shows the research framework that illustrates the relationships among the green operations, green innovation, and environmental performance.

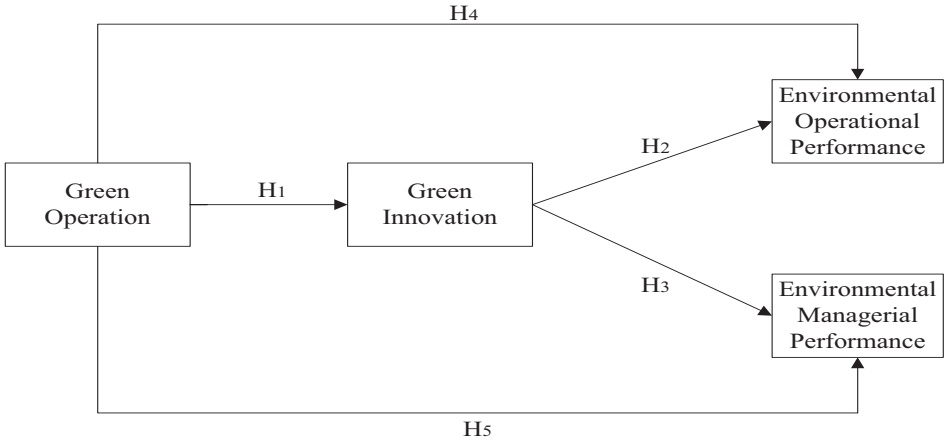


Figure 1 Conceptural Framework

RESEARCH METHODOLOGY

1. Pre-test and Questionnaires Development

The questionnaire consisted of four sections: (1) Green operations: reducing environmental impacts and testing top manager's and employee's eco-friendly concepts; (2) Green innovation: minimizing environmental pollution in SCM process compared with competitors; (3) Environmental operational performance; and (4) Environmental managerial performance. The items were modified based on pre-test interviews with five managers from the semi-conductor and computer related industries experts mentioned. Following the procedure recommended by Churchill (1979), the pre-test interviews indicated that questionnaire was appropriate to test the mediating effect of green innovation on green operations and environmental performance. A five-point Likert scale (1- "totally disagree" to 5- "totally agree") was used to measure items for green operations, green innovation, and environmental performance.

2. Data Collection

The population for this study was managers from the semi-conductor, information communication technology, and computer-related industries in Taiwan. Taiwan was chosen as the main research scope since this country is one of the major hi-tech original equipment manufacturers (OEMs) worldwide and environmental issues are currently perceived as greatly important to the above industries (Russo and Fouts, 1997). Questionnaires were sent to 587 general managers from the list of "Largest 5000 Corporations in the ranking of Taiwan". 141 valid responses were obtained from 150 received questionnaires, indicating a valid response rate of 24%.

3. Reliability and Validity Analysis

This study used SPSS12.0 and AMOS18.0 to analyze the data. For each latent construct, reliability and validity were assessed based on two-step procedure with sturctural equation modeling (SEM) approach which includes measurement model and structural model (Anderson and Gerbing, 1988). The results show that the factor loading coefficients were above 0.5, which fit the benchmark of 0.5 (Hair et al., 2010), and the SMC value were between 0.324 and 0.797, which are above the benchmark of 0.2 (Bentler and Wu, 1993), and the Cronbach's α coeefficients were between 0.812 to 0.859, which are above the benchmark of 0.7 (Nunnally, 1978). Hence, the achieved results suggest a high interna consistency, thus confirming reliability of each contruct. The AVE values were all above 0.5, indicating high convergent validity of the measurement indicators (Hair et al., 2010). This study also followed the ideas of Gaski and Nevin (1985) which are the coefficient between two latent constructs of Cronbach's α smaller than 1 and the square root of AVE are larger by paring two latent constructs suggested by Fornell and Larcker (1981). The statistic results fit the above suggestions, supporting discriminant validity.

Table 1 Correlation of Latent Variables

Variables	Green Operations	Green Innovation	Environmental operational performance	Environmental managerial performance	Composite reliability	AVE
Green Operations	.736				.904	.542
Green Innovation	.548**	.712			.858	.507
Environmental operational performance	.549**	.624**	.730		.820	.533
Environmental managerial performance	.441**	.555**	.633**	.766	.850	.586
Cronbach's α	.838	.812	.848	.859		

Note: *p＜.05;**p＜.01; ***p＜.001

STATISTICAL RESULTS

1. Evaluation of Rival Models

Hair et al. (2010) suggest utilizing rival models to verify the optimal hypothesis model, and then perform individual path coefficient test to confirm hypotheses. From previous liuterature, this study designs four rival models, as shown in Figure 2. The Model 1 (i.e. the completely mediated model) explored the mediating impact of green innovation in between green operations and environmental performance. Model 2 was partially mediated model which explored the impact of

green operations on green innovation; meanwhile, the paths related to environmental operational performance and environmental managerial performance were ignored. Model 3 examined the impact of green innovation on environmental operational performance and environmental managerial performance while the path related green operations were ignored. Model 4 presented the direct impact of green operations on environmental operational performance and environmental managerial performance whereas all indirect impact on path was ignored. Hypothetical model was a partially mediated model containing the impact of green operations on environmental operational performance and environmental managerial performance through the mediators of green innovation and the direct impact of green operations on environmental operational performance and environmental managerial performance. Table 2 shows the fit statics of rival model comparison. After the comparison between the path analyses of models 1-4, the hypothetical model was found to fit well with the data, indicating that green innovation should be added in between green operations and environmental operational performance and environmental managetial performance.

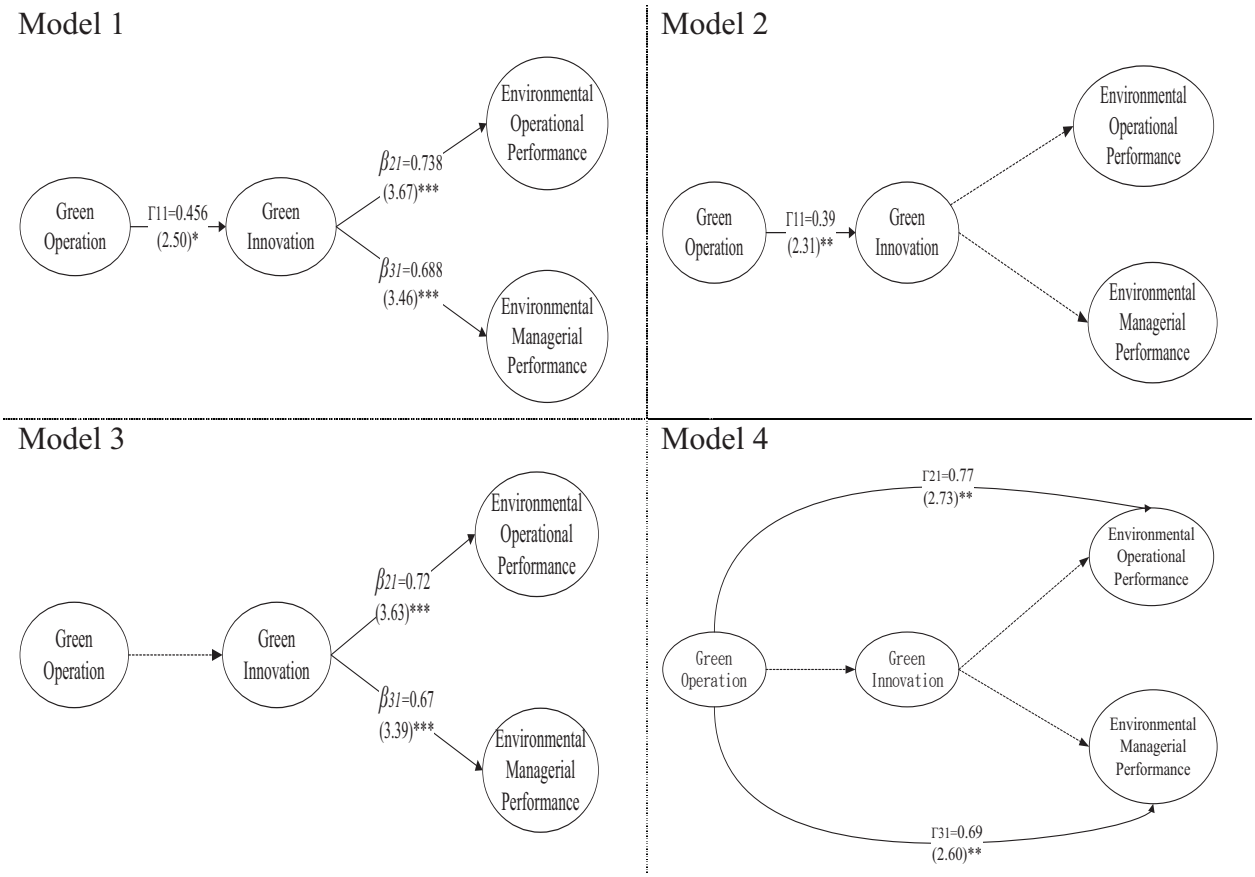


Figure 2 Rival Models

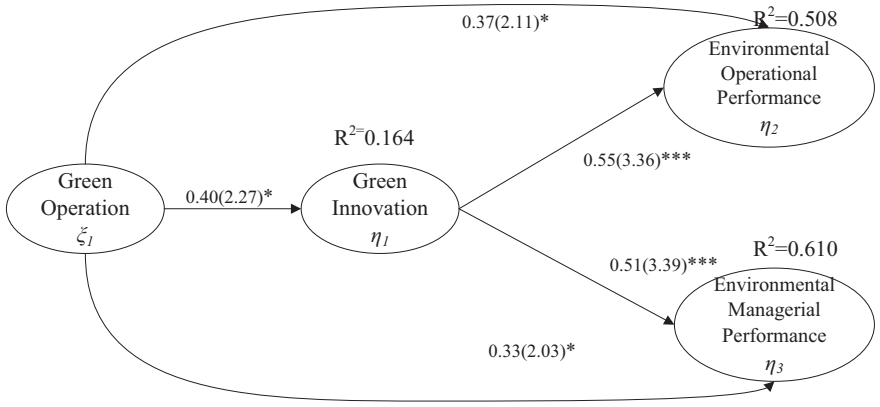
2. Overall Model Fit

This study adopted the idea of Hair et al. (2010) to choose absolute fit measures, incremental fit measures, and parsimonious fit measures to test the model fit. Absolute fit measures were to

measure overall goodness-of-fit for both the structural and measurement models collectively. Table 2 showed the achieved values for absolute fit measures respectively were x^2/df=1.24, GFI=0.865, AGFI=0.833, RMR=0.020, and RMSEA=0.042, indicating goodness-of-fit results. Incremental fit measures refered to measure goodness-of-fit that compares the current model to a specified independence nmodel to determine the degree of improvement over the null model. In Table 2, the obtained values for incremental fit measures respectively were NFI=0.702, IFI=0.924, TLI=0.910, and CFI=0.920. NFI was lower than the standardize value 0.9. Parsimonious fit measures refered to measure goodness fit representing the degree of model fit per estimated coefficient. The statistcs results of parsimonious fit measures were PNFI=0.620 and PGFI=0.698 , indicating the overall good model fit.

Table 2 Rival Model Comparison

Fit indicators	Model 1	Model 2	Model 3	Model 4	Hypothetical model	Limiting value	Fit result
Absolute Fit Measures							
x^2/df	1.25	1.69	1.317	1.565	1.24	1-5	Yes
GFI	.863	.816	.858	.836	.865	>.8	Yes
AGFI	.832	.776	.827	.799	.833	>.8	Yes
RMR	.029	.043	.032	.040	.020	<.05	Yes
RMSEA	.042	.071	.048	.64	.042	<.05	Yes
Incremental Fit Measures							
NFI	.672	.550	.652	.587	.702	>.9	No
IFI	.911	.748	.886	.797	.924	>.9	Yes
TLI（NNFI）	.896	.708	.868	.764	.910	>.9	Yes
CFI	.907	.737	.881	.789	.920	>.9	Yes
Parsimonious Fit Measures							
PNFI	.599	.495	.585	.526	.620	>.5	Yes
PGFI	.703	.761	.702	.684	.698	>.5	Yes



Note: * p<.05, **p<.01, ***p<.001

Figure 3 Hypothetical Structural Model

3. Empirical Result of Hypothetical Structural Model

The SEM approach was applied to test the causal relationship between lantent variables. Figure 3 shows the path analysis of hypothesized structural model. The statistics results show that green operations have positively impact on green innovation (γ11= 0.40, t = 2.27, p<0.05), green innovation has positively impact on environmental operational performance (β_{21}=0.55, t = 3.36, p<0.001), green innovation has positively influence on environmental managerial performance (β31=0.51, t= 3.39, p<0.001), green operations have positively impact on environmental operational performance (γ21=0.37, t= 2.11, p<0.05), and green operations have positively influence on environmental managerial performance (γ31 =0.33, t = 2.03, p<0.05).

Previous literature mainly explores the impact of green operations on environmental performance and the corelations among green innovation, environmental operational performance, and environmental managerial performance. However, there has been a lack of inverstigations on the mediating influence among the dimensions, which is the interest of this paper. The statistical results of all structural paths strongly supported proposed hypotheses, as shown in Table 3.

First, the hypothesis H1 is strongly supported, stating that green operations have a positive impact on green innovation. Hence, it can be confirmed that the more practice on green operations, the more high-tech firms can accelerate green innovation, which in turn helps acheive energy-saving goals, improve productive technology, enhance waste product reuse, and obtain more comtetitive advantages.

This study support hypotheses H2 and H3 that green innovation has positivily impact on environmental performance (i.e operational management, manegerial performance). Hence, through deeply considering product designs for easy recycle and reuse, emission disposal, and adjusting devision of authority, the high-tech industry can not only better save water and engry but also improve internal administration and information delivery as well as ensure industrial substantial safety.

The finding support H4 and H5 that green operations have positivily impact on environmental performance (i.e. operational management, menegerial performance). Through designing new products to reduce product life cycle impact, supervisors and employees implement emvironmental issues in daily operational and manufacturing activities to use adjusted environmental products to establish waste and material categorization systems and to practice long-term green philosophy. Simultaneously, the manufa tured green products can substantially assist firms in reducing air pollution, ing greenhouse gap emission, diminishing cost, and increasing production output.

Finally, this study aims to explore the mediating effect of green innovation on green operations and environmental performance. The empirical results show that green operations implementation can effectiveily improve environmental operational performance and environmental managerial performance through green innovation strengthening. Hence, it is suggested that green design through using improved environmental products and reusing waste

materials, green processes through effectively minimizing toxic emission and reducing waste, and green administration through falicitating internal information delivery and supporting the adoption of new environmental policies have all effectively benefit environmental performance by reducing environmental pollution, industrial safety accidents, and scarced water and engry consumption.

Table 3 Path Coeffieient and Hypothesis Testing

Hypotheses	Path coefficient	*T* value	Results
H_1 Green operations→ Green innovation	.40	2.27*	Supported
H_2 Green innovation→ Environmental operational performance	.55	3.36***	Supported
H_3 Green innovation→Environmental managerial performance	.51	3.39***	Supported
H_4 Green operations→ Environmental operational performance	.37	2.11*	Supported
H_5 Green operations→ Environmental managerial performance	.33	2.03*	Supported

Note：* p<.05；**p<.01；***p<.001

CONCLUSION AND IMPLICATION

The current study mainly explores the whether the application of green operation model in high-tech industry would affect organizational environmental performance through green innovation. Through verifying the hypothetical models, this empirical study have successfully clarified the relationship between all variables and in turn addressed all research questions. The results show that the import of green operation model positively affects green innovation. In other words, the more practicable green operational model will definitely lead to the more promotional green innovation. This finding strongly supports previous studies that green operational model has a positive impact on green innovation (Winn and Roome, 1993; Ottman, 1999; Marcus, 2007). Second, this study confirms that the strengthening of green innovation will positivily affect environmtnal operational performance, hence implying that manufacturers should emphatically stimulate green innovation in order to obtain better environmental operational performance. This finding is consistent with previous research that green innovation positivily affects environmental operational performance (Geffen and Rothenberg, 2000; Rosa and Pierpaolo, 2010). Third, the achieved results suggest that the enhancement of green innovation will positivily affect environmental managerial performance, which support the extant literature (Shrivastava, 1995). Forth, better green operations are proposed to positivily affect environmtnal operational performance, which is in line with previous studies (Theyel, 2001; Chien and Shih, 2007). Finally, this study finds that better implementation of green operations can effectively improve environmental managerial performance, confirming the results obtained in previous research (Chien and Shih, 2007; Chen, 2008).

With achieved relationships among green operations, green innovation, environmental operational performance, and environmental managerial performance, this study provided several useful contributions and academic implications. Firstly, in the context that green issues are currently the novel theme for research and have attracted increasing attention from managers but there remains the lack of empirical studies among green operations, green innovation, and

environmental performance, this study has contributed to the extant literature with the model combining these aspects. Second, by putting forward that the integrating of green operations and green innovation affects organizational environmental performance more positively than the sole impact of green operations on organizational environmental performance, this study has suggested manufacturers should pay more attention to develop related strategies to better cope with customer demand, thus acehive better customer satisfaction and sutainable operation. As such, the research findings have provided helpful academic references and managerial guidelines for firms in gaining competitive environmental performance.

It is noted that nurmous industries currently set their goals on benefits regardless environmental protection, which in turn causes serious demange on environment. This study finds that green operations have a direct and positive impact on green innovation. In other words, once importing green operation model, high-tech industries will gain more benefits in propoting green innovation. Green innovation capability enhancement, in turn, facilitates the industries in skipping over the competition of Red Ocean, creating their own competitiveness, reducing environmental demange, and obtaining more benefits as well as the win-win situation between industry and environment. Moreover, this study also finds that green operations have a direct and positive impact on environmental performance through green innovation, implying that green innovation is a critical factor of promoting environmental performance in high-tech industry. Therefore, in the context that public is currently paying more attention to environmental issues in industries, once firms attempt to improve green innovation, they would definitely achive greater benefits on eco-environment and more positive industry image, thus result in better organizational operational performance and organizational managerial performance, indicating a triple-win aspects among industry, publics, and environment.

Despite the above contributions, this study remains several limitations. Due to sample restriction, future studies are encouraged to expand the sampling subjects to different industries (e.g. food industry, logistics). Since many questionnaire items regarding green operations, green innovation, and organizational performance possibly cause respondents to lose patience, further assessment for items is recommended. It is also suggested that data should be collected using vertical section and time-series methods and to explore the interations among variables in different time situation for deeply observing variations and seeking more valid results. Finally, in addition to understand the impact of different factors and results, comparative analyses may be effective to seek for reliable empirical study.

REFERENCES

1. Anderson, J.C., and Gerbing, D.W. (1988), “Structural equation modeling in practice: A review and recommended two-step approach”, *Psychological Bulletin*, 103(3), 411-423.
2. Belz, F., and Bilharz, M. (2005), *Nachhaltigkeits-Marketing in Theorie und Praxis*, Germany: Wiesbaden.
3. Bentler, P.M., and Wu, E.J.C. (1993), *EQS/Windows User’s Guide. Los Angeles: BMDPStatistical Software*.
4. Bhamra, T.A. (2004), “Ecodesign: The search for new strategies in porduct development. Proceedings of the Institution of Mechanical Engineers”, *Journal of Engineering*

Manufacture, 218(5), 557-569.
5. Birkinshaw, J., Hamel, G., and Mol, M.J. (2008), "Management innovation," *Academy of Management Review*, 33(4), 825-845.
6. Chen, Y.S. (2008), "The driver of green innovation and green image - Green core competence", *Journal of Business Ethics*, 81(3), 531-543.
7. Chen, Y.S., Lai, S.B., and Wen, C.T. (2006), "The influence of green innovation performance on corporate advantage in Taiwan", *Journal of Business Ethics*, 67(4), 331-339.
8. Chien, M. K., and Shih, L. H. (2007), "An empirical study of the implementation of green supply chain management practices in the electrical and electronic industry and their relation to organizational performances", *International Journal of Environmental Science and Technology*, 4(3), 383-394.
9. Cooper, M., and Ellram, L. (1993), "Characteristics of Supply Chain Management and its Implications for Purchasing and Logistics Strategy", *International Journal of Logistics Management*, 4(2), 13-24.
10. Edeltraud, G., and Lilly, S. (2006), "The hurdle analysis: A self evaluation tool for municipalities to identify, analyses and overcome hurdles to green procurement", *Corporate Social - Responsibility and Environmental Management*, 13(2), 61-77.
11. Fleischmann, M., Bloemhof-Ruwaard, J.M., Dekker, R., van der Laan, E., van Nunen, J.A.E.E. and Van Wassenhove, L.N. (1997), "Quantitative models for reverse logistics: A review," *Europe Journal Operational Research*, 103(1), 1–17.
12. Fornell, C., and Larcker, D.F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research*, 18(1), 39-50.
13. Frentzel, D.G., and Sease, G.J. (1996), "Logistic-Taking Down the Wall", *Annual Conference Proceeding*, 48, 645-654.
14. Gaski, J.F., and Nevin, J.R. (1985), "The differential effects of exercised and unexercised power sources in marketing channel", *Journal of Marketing Research*, 22(5), 130-142.
15. Geffen, C.A., amd Rothenberg, S. (2000), "Suppliers and environmental innovation: The automotive paint process", *International Journal of Operations and Production Management*, 20(2), 166-168.
16. Geyer, R., and Jackson, T. (2004), "Supply loops and their constraints", *California Management Review*, 46(2), 55-73.
17. Green, K., Morton, B., and New, S. (1996), Purchasing and environmental management: interactions, policies and opportunities, Business Strategy and the Environment, 5(3), 188–197.
18. Gupta, M. (1995), "Environmental management and its impact on the operations function", *International Journal of Operations & Production Management*, 15(8), 34-51.
19. Hair, J.F., Black, W. C., Babin, B.J., and Anderson, R.E. (2010). *Multivariate data analysis: A global perspective* (7th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.
20. Hanna, M.D., and Newman, W. (1995), "Operations and the environment: an expanded focus for TQM"', *International Journal of Quality &Reliability Management,* 12(6), 38-53.
21. Hervani, A.A., Helms, M.M., and Sarkis, J. (2005), "Performance measurement for green supply chain management", *Benchmarking*: *An International Journal*, 12(4), 330-353.
22. Kammerer, D. (2009), "The effects of customer benefit and regulation on environmental product innovation. Empirical evidence from appliance manufacturers in Germany",

Ecological Economics, 68(8), 2285-2295.
23. Ken, P., and Martin, C. (2007), *Green Marketing*, Butterworth-Heinemann: Oxford, pp. 562-585.
24. Kim, N., and Srivastava, R. (1998). Managing intraorganizational diffusion of technological innovations. *Industrial Marketing Management,* 27(3), 229– 246.
25. Klassen, R., and Mclaughlin, C. (1996), "The impact of environmental management on firm performance", *Management Science*, 42(8), 1199-1214.
26. Klemmer, P., Lehr, U., and Klaus, L. (1999), "Environmental Innovation. Incentives and Barriers," *German Ministry of Research and Technology (BMBF)*, Berlin.
27. Marcus, W. (2007), "Empirical influence of environmental management on innovation: Evidence from Europe", *Ecological economics*, 66(2-3), 392-402.
28. Meeus, M.T.H., and Edquist, C. (2006), "Introduction to part 1: Product and process innovation," In Hage, J. and Meeus, M. T. H. (Eds.), *Innovation, science and institutional change*, Oxford: Oxford University Press.
29. Narasimhan, R., and Carter, J.R. (1998), "Linking business unit and material sourcing strategies", *Journal of Business Logistics*, 19(2), 155-172.
30. Newman, J.C., and Breeden K.M. (1992), "Managing in the environmental era-lessons from environmental leaders", *The Columbia Journal of World Business*, 27(3), 211-221.
31. OECD, (2005), *The Oslo Manual-Guidelines for Collecting and Interpreting Innovation Data (3th Ed.)*, France: OECD.
32. Ottman, J. (1999), *Environment consumerism: What every marketer needs to know*, New York: Ottman Consulting.
33. Oltra, V., and Saint Jean, M. (2009), "Sectoral systems of environmental innovation: An application to the French automotive industry", *Technological Forecasting & Social Change*, 76(4), 567-583.
34. Papadopoulos, A.M., and Giama, E. (2007), "Environmental performance evaluation of thermal insulation materials and its impact on the building", *Building and Environment*, 42(5), 2178-2187.
35. Peattie, K. (1992), *Green Marketing*, London: Pitman Publishing, pp.169-171.
36. Porter, M.E. (1991), "America's Green Strategy", *Scientific American*, 264(4), 1-68.
37. Pujari, D. (2006), "Eco-innovation and new product development: Understanding the influences on market performance", *Technovation*, 26(1), 76-85.
38. Qi, G.Y., Shen L.Y., Zeng, S.X., and Ochoa J.J. (2010), "The drivers for contractors' green innovation: An industry perspective", *Journal of Cleaner Production*, 18(14), 1358-1365.
39. Rao, P., and Holt, D. (2005), "Do green supply chains lead to competitiveness and economic performance", *International Journal of Operations & Production Management*, 25(9), 898-916.
40. Rennings, K. (2000), "Redefining innovation: Environmental innovation research and the contribution from ecological economics", *Ecological Economics*, 32(2), 319-332.
41. Rosa, M.D., and Pierpaolo, P. (2010), "From green product definitions and classifications to the Green Option Matrix", *Journal of Cleaner Production*, 18(16-17), 1608-1628.
42. Russo, M., and Fouts, P. (1997), "A resource-based perspective on corporate environmental performance and profitability", *Academy of Management Journal*, 40(3), 534-559.
43. Sarkis, J. (2003), "A strategic decision framework for green supply chain management", *Journal of Cleaner Production*, 11(4), 397-409.

44. Schoell, W. F., and Guiltinan, J. P. (1993), *Marketing Essentials*, NJ: Prentice-Hall.
45. Shrivastava, P. (1995), "The role of corporations in achieving ecological sustainability", *Academy of Management Review*, 20(4), 936-960.
46. Steger, U. (1993), "The Greening of the Board Room：How German Companies are Dealing with Environmental Issues," *Environmental Strategies for Industry*, Washington D.C.：Island Press.
47. Tao, R. (2009), "Barriers and drivers for process innovation in the petrochemical industry: A case study", *Technol Manage*. 26(4), 285-304.
48. Taylor, S.R. (1992), "Green management: The next competitive weapon", *Futures*, 24(7), 669-680.
49. Theyel, G. (2001), "Customer and supplier relations for environmental performance", *Greener Management International*, 35, 61-69.
50. Tsoulfas, G.T., and Pappis, C.P. (2006), "Environmental principles applicable to supply chains design and operation", *Journal of Cleaner Production*, 14(18), 1593-1602.
51. US-AEP, (1999), "Supply Chain Environmental Management-Lessons for Leader in the Electronic Industry", *Clean Technology Environment Management Program*, 21-22.
52. Van Weele, A.J. (2002), *Purchasing and supply chain management: analysis, planning and practice*, Thomson: London.
53. Winn, S.F., and Roome, N.J. (1993), "R&D management response to the environment: Current theory and implications to practice and research", *R&D Management Review*, 23(2), 147-160.
54. Zhang, Q., and Li, M. (2009), "Research on Green Supply Chain Construction and Operation of Automobile Enterprise", *International Conference on Information Science and Engineering*, 1, 4432-4435.
55. Zhu, Q., and Sarkis, J. (2004), "Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises", *Journal of Operations Management*, 22(3), 265-289.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

KNOWLEDGE DYNAMICS AND INNOVATION: CASE STUDIES IN A SPARSELY POPULATED AREA

Harri Jokela*, Oulu Southern Institute, University of Oulu, Finland
harri.jokela@oulu.fi

Eija-Riitta Niinikoski, Oulu Southern Institute, University of Oulu, Finland
eija-riitta.niinikoski@oulu.fi

Matti Muhos, Oulu Southern Institute, University of Oulu, Finland
matti.muhos@oulu.fi
***Corresponding author**

ABSTRACT

Purpose: *This study describes the sources of essential knowledge for the innovation cases in three micro companies and analyses the knowledge dynamics in these cases. This study seeks to answer the following questions: What are the sources of essential knowledge for the innovation cases in the three micro companies selected? What kind of knowledge is required in these cases, and what phases can be identified in these innovation cases? These questions are answered through a multiple case study that uses the knowledge biography technique.*
Method: *This is a multiple case study with holistic strategy. The unit of analysis is the innovation case. We analyse innovation cases in three micro companies operating in the Oulu South region. At the heart of the study is the knowledge biography technique, an innovative approach that provides a deeper understanding of knowledge dynamics in firms and regions. The empirical data was gathered through semi-structured interviews and public archives related to the case company. The interviews with key informants were mainly conducted face-to-face during fieldwork in 2013. The data was analysed using an inclusive and iterative process, and the main findings were summarised.*
Findings: *We tracked the sources of essential knowledge for the three innovation cases and the knowledge dynamics of these cases were described by using the knowledge biography method. This study will serve as an interesting benchmarking tool for any public organisation that offers business services to companies. The findings suggest that public actors should pay more attention to the case-specific needs of innovative micro companies while developing their services.*
Value: *In the future studies, it would be interesting to analyse more innovation cases using the knowledge biography technique and make comparisons among these cases.*

Keywords: Knowledge dynamics, knowledge biography, innovation, micro company, growth, Finland
Category: Case study

INTRODUCTION

Knowledge is generally connected to innovation. In fact, changes in knowledge can be seen as the driving force behind innovation, and the general product/innovation lifecycle can be divided into generic phases, stages or states in multiple ways (e.g. Dean, 1950, Golder and Tellis, 2004, Markusen et al., 1986, Schutjens and Stam, 2003). This study aims to describe

the sources of knowledge that are essential for the innovation cases in three micro-companies located in Oulu South region and analyse the knowledge dynamics in these cases.

The Oulu South region is situated in the southern part of Northern Ostrobothnia in Finland. This region is not a governmental unit or area but was formed to increase inter-municipal cooperation and development and to gain the required critical mass to ensure national and international competitiveness. The region comprises three subregions and 14 municipalities, with approximately 90,000 inhabitants and 4,600 active companies. Oulu South is one of Finland's main rural areas; however, because it offers sufficient employment to its inhabitants, it is known as the 'industrialised countryside'. Furthermore, although the unemployment rate in this region is the lowest in northern Finland, it is likely to retain a large proportion of its younger population because it has the highest birth rate in Finland, despite the demographic challenge of widespread emigration from the region. This distinguishes the Oulu South region from other rural areas in Finland, many of which are dealing with significantly ageing populations.

In this study, we investigate three innovation cases in micro companies located in the Oulu South region:

Case 1. Development of a vertical lifting fabric fold-up outer door.
Case 2. Development of a method to process and convert the ash generated by power plants to end-of-waste products.
Case 3. Development of an internet application for electricity price comparison and contract rating.

This study focuses on the knowledge dynamics of these three innovation cases to garner a better understanding of how knowledge is developed and transferred at a firm level. The aim of studying knowledge dynamics is to unravel the processes of knowledge interactions and to identify the types of actors that are involved in these processes. Therefore, we defined the following research questions:

1. What are the sources of knowledge that are essential for the three innovation cases?
2. What kind of knowledge is required and what phases can be identified in the three innovation cases?

To address these research questions, multiple case studies were conducted. This was deemed the optimum approach for the purposes of our study. According to Yin (1989, p. 23), 'a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not evident and in which multiple sources of evidence are used'. An essential part of this study was to conduct in-depth interviews with the key informants of each innovation case. Because this study deals with interactions among actors and particularly aims to evaluate knowledge exchange and development, this was deemed the best way to obtain considerable information regarding these processes. The information obtained through the interviews was analysed by predominantly using the knowledge biography technique.

This study may enable public actors to ask essential questions for developing their services for micro companies, thereby fostering regional development and economic growth. According to Crevoisier and Jeannerat (2009, p. 1228), those regions that are capable of imagining their local activities within a global environment are categorized as innovative

regions. To be innovative, a region must be capable of matching its dynamics to the generation and utilization of knowledge.

This study is made up of five sections. In the introduction, the background, motivation, research problem and research questions are presented. In the second section, the theoretical background of the study is presented, and a brief survey of the relevant knowledge dynamics, types and phases is conducted. In the third section, the method undertaken in this study is described. In the fourth section, a description and analysis of the data garnered in case studies are undertaken; these findings are then examined in light of the research questions. In the final section, a discussion of the main results and opportunities for further research is presented.

KNOWLEDGE DYNAMICS

Knowledge is widely regarded as a useful economic resource. In this context, it has been defined as the learning process in human brains, which is generated and used in personal and collective interactions in various contexts and uses given individual and firm competences to appropriate new and necessary economically useful knowledge (Dahlström and Hedin, 2010, p. 6). Therefore, knowledge is seen as both a resource and a process, both of which are linked to the interactions that occur among actors in the concept of knowledge dynamics. According to Strambach (2008, p. 154), the visible results of knowledge dynamics are innovations in products, services or processes. Knowledge dynamics can be understood as the dynamics that emerge from the processes of creation, usage, transformation, movement and diffusion of knowledge. Knowledge is not static; rather, it is constantly changing and dependent on context and application.

For the purposes of this empirical case study, analytical, synthetic and symbolic knowledge were considered most relevant. Analytical knowledge is defined as research-based knowledge, which is developed through scientific exploration. Synthetic knowledge is considered a combination of analytical and (perhaps) symbolic knowledge. Engineering knowledge is a good example of synthetic knowledge, because it is derived from application and scientific research. Symbolic knowledge is largely recognised in research on cultural or creative industries. It deals with ideas, symbols and socially constructed commodities. It has been referred to as the knowledge about representation (Asheim and Coenen, 2006, Strambach, 2008).

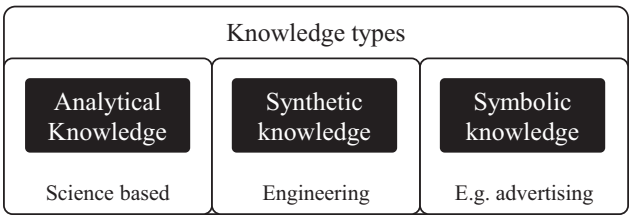


Figure 1. Types of knowledge

Knowledge phases seldom progress linearly. Usually, development progresses in such a way that various phases occur at the same time. In fact, there may even be loops between these phases. To understand the complexity of knowledge dynamics as a part of the process of innovation, the following three knowledge phases are examined in this study: exploration, examination and exploitation.

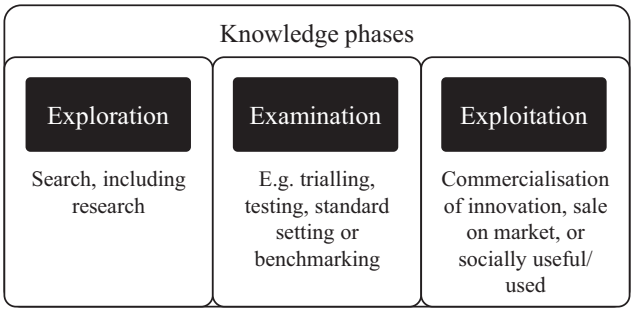


Figure 2. Knowledge phases

The exploration phase is often described as the first step in the knowledge chain. This phase usually involves searching for new knowledge or maintaining and developing existing knowledge. Examination is a testing phase in which the veracity and applicability of the knowledge is considered. Exploitation is regarded as a 'selling' and 'using' phase in which knowledge is applied to a situation in return for financial, status, position or recognition gains (Halkier et al., 2010, Strambach, 2008).

METHODOLOGY

We used a multiple case study with holistic strategy. The case study followed the process presented in Figure 1.

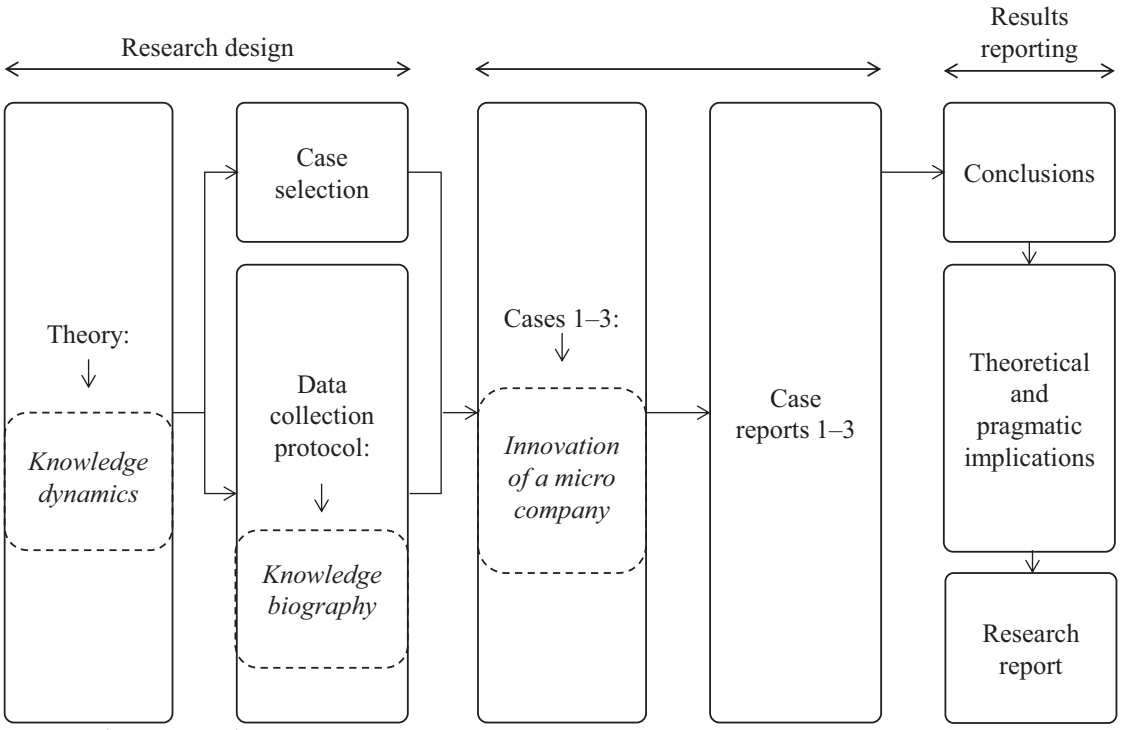


Figure 3. The research process

The study analysed the process of innovation cases in three micro companies. The definition of a micro company (and SME) is different in different contexts. The US context, for example, offers many definitions of SME, depending on the industry. For example, in some industries, an SME is defined as any company having fewer than 500 employees. In the European context, an SME is defined as any company having fewer than 250 employees. The

same disparity applies to micro companies and should be taken into account when studying the SME-related literature. Ayyagari et al. (2007) cover this topic in their globally focused, statistical study on SMEs (p. 416): 'The term SME covers a wide range of definitions and measures, varying from country to country and varying between sources reporting SME statistics. Some of the commonly used criteria are the number of employees, total net assets, sales, and investment level. However, the most common basis for definition is employment, and here again, there is variation in defining the upper and lower size limit of an SME. Despite this variance, a large number of sources define an SME to have a cut-off of 250 employees'. Because of the European context of this case study, we utilise the European definition. Within the SME category, the European Union defines medium-sized firms as having 50-249 employees, small firms as having 10-49 employees and micro-firms as having 0-9 employees (Storey, 2003).

In this study, the empirical data was gathered through semi-structured interviews and public archives related to each company in question. Most of the interviews with key informants were conducted face-to-face during fieldwork. The questionnaires were designed to obtain information from the informants on various questions including the following: How did the innovation process develop from idea to product? What important knowledge interactions occurred during the development of the product? Who were the main actors involved in the development process? Where were they located? What type of knowledge did they contribute to the process? What core knowledge was involved in the genesis and development of this innovation? How did the core knowledge of the innovation arise and how was it developed?

The knowledge biography technique—an innovative approach that provides a deeper understanding of knowledge dynamics in firms and regions—was used as the main technique for interpreting and analysing the data. The essential sources of knowledge for each innovation case were tracked, and interviews were used to obtain basic information regarding the time and space dimensions of the knowledge dynamics that occurred as a part of the cases. The knowledge biography technique permitted us to capture the diversity of the social environment of each firm to determine the precise manner in which knowledge was transmitted and information was exchanged from various partners inside and outside the firm (Dahlström and Hedin, 2010, p. 11).

CASE STUDIES

In this section, we describe the essential knowledge sources for the three innovation cases and analyse the knowledge dynamics in these cases. Moreover, the detailed knowledge biography of each innovation case is presented.

The three innovation cases analysed in this study are as follows:
Case 1. Development of a vertical lifting fabric fold-up outer door.
Case 2. Development of a method to process and convert the ash generated by power plants to end-of-waste products.
Case 3. Development of an internet application for electricity price comparison and contract rating.

Case 1

Innovation case 1 is the development of a vertical lifting fabric fold-up outer door. Based on the data obtained from the interviews, three innovation phases were identified:
1. First version, 1993–1998
2. Product development, 1999–2004
3. Marketing and internationalisation, 2005–

Figure 4 illustrates the innovation phases and key knowledge interactions among the actors in case 1. The owner of the innovation remained the same (i.e. company 1) during the development process.

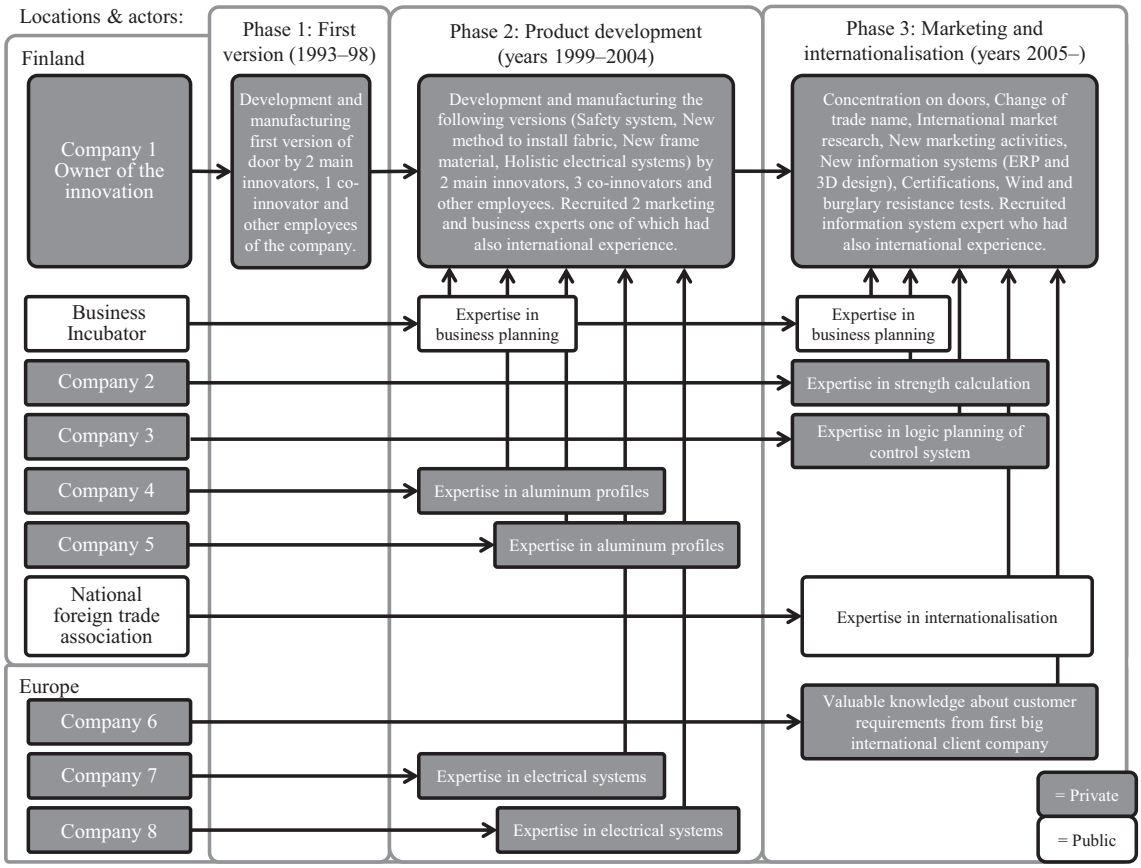


Figure 4. Knowledge biography of innovation case 1

The idea was based on the following question posed by one customer in 1993: 'Could you make us an outer door with a basic structure that is similar to your indoor divider wall?' Two main innovators made a plan for modifying the divider wall to outer door. Subsequently, the first version of outer door was manufactured and sold to the customer in 1993. The entire planning and manufacturing process was completed by the staff of company 1 in phase 1.

The employees of company 1, who had considerable experience in manufacturing tailor-made sunblinds, sunshades and divider walls, contributed the most important knowledge to the development process. In phase 2, the expertise of several external experts was introduced to the process. In phase 3, internationalisation expertise was introduced to the development process by a public organisation and knowledge regarding customer requirements was introduced to process by the first big international client company***Case 2***

Innovation case 2 is the development of a processing method for ash from power plants. Based on the data obtained from the interviews, three innovation phases were identified:
1. Ideation, 2002–2008
2. Product development and marketing, 2009–2011
3. Commercialisation, 2012–

Figure 5 illustrates the innovation phases and key knowledge interactions among the actors in case 2. Two individuals (i.e. the main innovators) were the owners of the innovation in phase 1. Subsequently, the company (i.e. company 1), which was founded in 2009 by the main innovators, was the owners of the innovation.

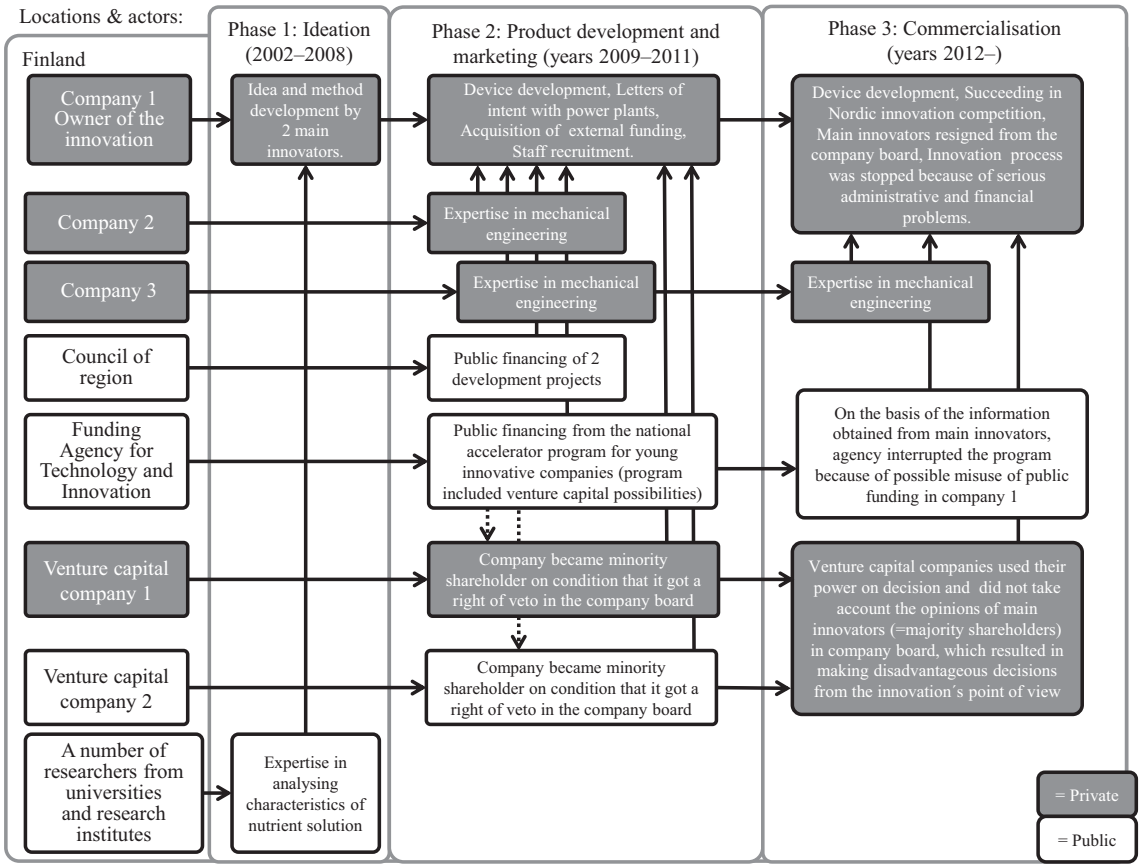


Figure 5. Knowledge biography of innovation case 2

The innovation idea was based on a research that was initiated in the 1960s on the utilisation of ash in forest fertilization by one of the main innovators. In 2002, he asked the other main innovator to help him commercialise the nutrient solution, which he had been successful in separating from ash. The other main innovator immediately noticed the business possibilities associated with possessing expertise in ash processing. Subsequently, the main innovators independently began developing the method of ash processing in phase 1. The objective was to create a method and device that enables the processing and conversion of ash to end-of-waste products. The Ash generated by power plants is classified as waste, which causes significant waste handling costs for power plants.

The most important knowledge was introduced in the development process by the two main innovators, one of whom had significant working experience in the research sector. The other

main innovator had considerable and varied experience in business, development and planning. He had a many-sided education and had also made 15 patented inventions. External experts mainly participated in the process in phase 2 when the construction of the device was in progress. Public actors participated to the process mainly by financing the development of the method and device. In this case, the influence of the venture capital companies was especially noteworthy. The venture capital companies displaced the main innovators from the operational decision-making in the board of the company 1, which caused serious administrative and financial problems and at the end the failure of the entire development process.

Case 3

Innovation case 1 is the development of an internet application for electricity price comparison and contract rating. Based on the data obtained from the interviews, three innovation phases were identified:
1. Ideation, 2007–2009
2. Product development, 2010–2012
3. Commercialisation, 2013–

Figure 6 illustrates the innovation phases and key knowledge interactions among the actors in case 3. One individual (i.e. main innovator) was the owner of the innovation in phase 1. Subsequently, the company (i.e. company 1), which was founded in 2010 by the main innovator, was the owner of the innovation.

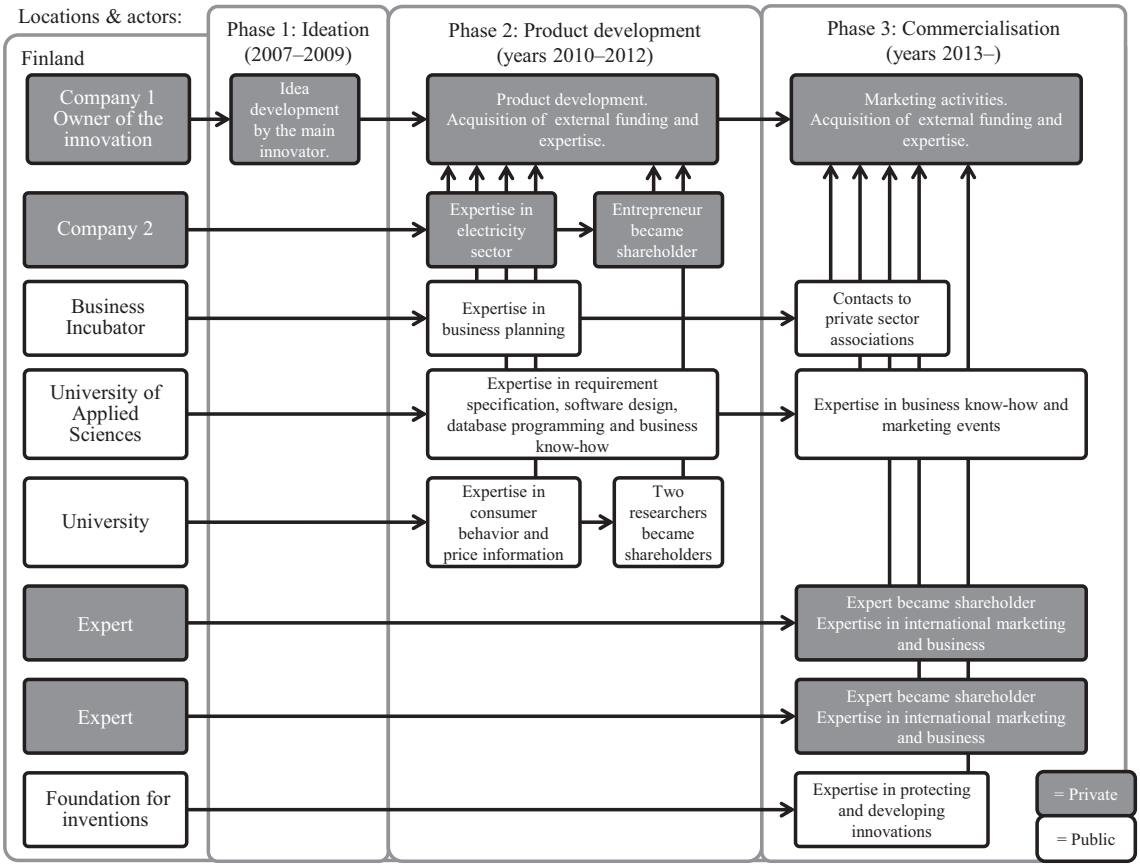


Figure 6. Knowledge biography of innovation case 3

The main innovator got the idea of developing an internet application for electricity price comparison and contract rating in 2007 while working in a company that operated as an electricity supplier. At the time, the public believed that traditional internet applications for electricity price comparison only provided a minor benefit to the consumers. This belief of the public gave the innovator the insight that the criteria for price formation in the electricity sector are very non-transparent for customers. The main innovator also noticed that there was no internet service in the market that transparently presents the criteria for electricity price formation and contract rating. The main innovator independently developed the idea further in phase 1, after which he resigned from his job and founded a new company (i.e. company 1).
The most important knowledge was introduced in the development process by the main innovator, who had extensive and varied working experience in the electricity sector and was a certified electronics technician. In phases 2 and 3, several external experts brought many-sided expertise to the process. Public actors played an important role, especially in phase 2.

DISCUSSION

This study described how the innovation process develops from the conception of an idea to a product in three innovation cases and analyses the knowledge dynamics within those processes. The detailed knowledge biographies of the three innovation cases, as presented in the previous chapter, answered research question 1.

Figures 7–9 briefly answer research question 2. In Figures 7–9, the innovation processes occur within a framework of knowledge types and knowledge phases (See Figures 1 and 2), according to the theoretical analysis conducted in this study.

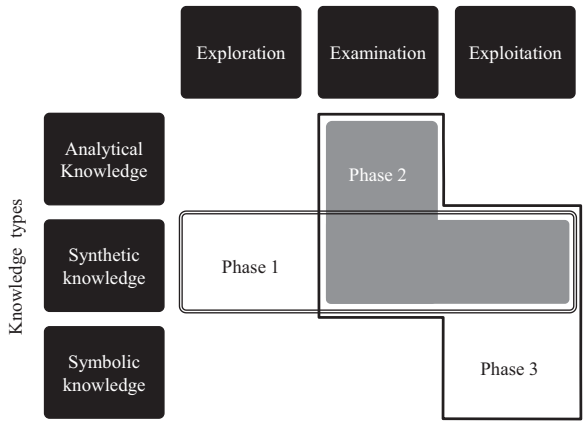


Figure 7. Case 1: The phases of the innovation process, projected through knowledge types and knowledge phases

In case 1, during the first phase of the innovation process (first version), synthetic knowledge was essential and all the knowledge phases (exploration, examination and exploitation) were identified. The entire planning and manufacturing process was done by the staff, which had extensive experience in tailor-made manufacturing. The first version of the door was manufactured straight to the customer, which means that no prototypes were made. The second phase (product development) was an examinative and exploitative knowledge phase in which both analytical and synthetic knowledge was essential. External expertise was necessary when the door improvements were in progress. Two marketing experts were recruited by company 1 in phase 2, which accelerated the innovation process. The third phase

(marketing and internationalisation) was an examinative and exploitative knowledge phase and all knowledge types were essential. External expertise was especially required in internationalisation activities. One expert was recruited in phase 3 to help in planning and using the new information systems.

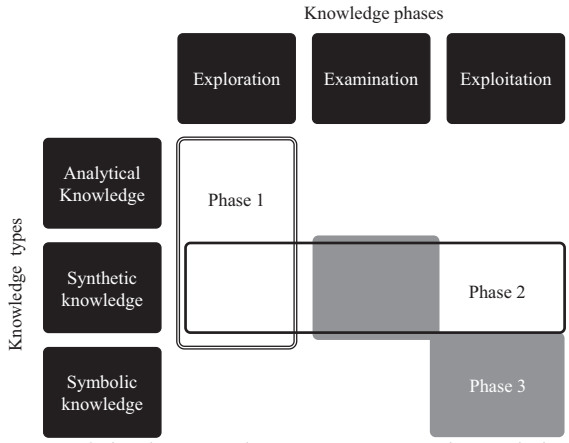


Figure 8. Case 2: The phases of the innovation process, projected through knowledge types and knowledge phases

In case 2, the first phase of the innovation process (ideation) was clearly an explorative knowledge phase in which both analytical and synthetic knowledge was essential. The main innovators were successful in independently developing the idea further because they had many-sided working experience and education. In the second phase (product development and marketing), synthetic knowledge was essential and all the knowledge phases (exploration, examination and exploitation) were identified. External expertise was required for device development and construction. The business experience of the other main innovator was useful when negotiating about letters of intent with power plants in phase 2. The third phase (commercialisation) was an examinative and exploitative knowledge phase in which synthetic and symbolic knowledge was essential. In phase 3, the peculiar behaviour of the venture capital companies resulted in the failure of the entire development process.

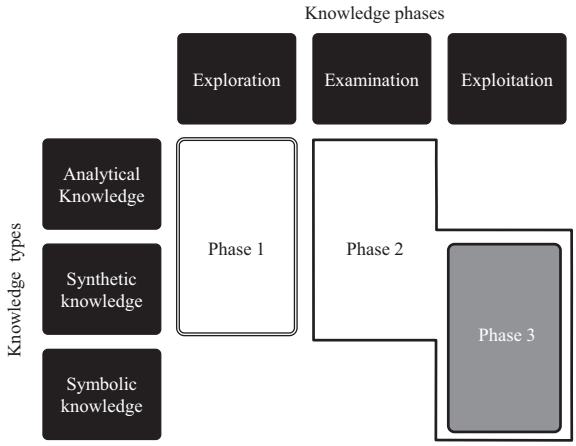


Figure 9. Case 3: The phases of the innovation process, projected through knowledge types and knowledge phases

In case 3, the first phase of the innovation process (ideation) was clearly an explorative knowledge phase in which both analytical and synthetic knowledge was essential. The main

innovator was successful in independently developing the idea further, because he had many-sided knowledge about the electricity sector. The second phase (product development) was much more complex; it was an examinative and exploitative knowledge phase wherein all knowledge types were essential. External experts introduced important knowledge to the process, especially for the planning and programming of the application. The third phase (commercialisation) represents the exploitative knowledge phase. In this phase, symbolic and synthetic knowledge was decisive. In this phase, external experts introduced important business and marketing knowledge to the process.

In cases 2 and 3, the owner of the innovation was a young company, which partially explains the fact that public actors and public funding were more important in the innovation process in these cases. The owner of the innovation in case 1 was an old company, which acted independently during the process. In case 1, other companies provided a large part of the expertise that was required during the process and numerous public actors were involved. In cases 2 and 3, the companies made several prototypes of the product; however, in case 1, the company manufactured the first version of the door straight to the customer. Despite the differences in the three cases, the basis of the innovations in all the three cases was the extensive working experience of the main innovators. It is also noteworthy that in all three cases, the companies naturally collaborated with the actors outside their home region.

The findings of this study suggest that while developing their services, public actors should pay more attention to catering to the case-specific needs of innovative micro companies. The results of this study show how micro companies can function effectively with limited financial and human resources.

In future studies, it would be interesting to use the knowledge biography technique to examine more innovation cases in micro companies. We hope to refine and develop this technique and subsequently apply it to future studies. We also suggest that future research examines the results of similar analyses made in micro companies in other countries.

ACKNOWLEDGEMENTS

This study is an essential part of the Entrepreneurship Research and Development of RDI in Oulu South Region –project. The authors are grateful for the project funding supported by the Council of Oulu Region, the Kerttu Saalasti Foundation, the Nivala-Haapajärvi subregion, the Ylivieska subregion, the Haapavesi-Siikalatva subregion, the Central Ostrobothnian University of Applied Sciences, the Educational Municipal Federation JEDU and the European Regional Development Fund. We highly appreciate the organisations and persons involved in the study who shared their experiences.

REFERENCES

1. Asheim, B.T., and Coenen, L. (2006), ‘Contextualising Regional Innovation Systems in a Globalising Learning Economy: On Knowledge Bases and Institutional Frameworks’, *The Journal of Technology Transfer*, Vol. 31 No. 1, pp. 163-173.
2. Ayyagari, M., Beck, T., and Demirguc-Kunt, A. (2007), ‘Small and medium enterprises across the globe’, Small Business Economics, Vol. 29 No. 4, pp. 415-434.
3. Crevoisier, O., and Jeannerat, H. (2009), ‘Territorial Knowledge Dynamics: From the Proximity Paradigm to Multi-location Milieus’, *European Planning Studies*, Vol. 17, No. 8, pp. 1223-1241.

4. Dahlström, M., and Hedin, S. (eds.) (2010), *Regional Trajectories to the Knowledge Economy–Nordic-European Comparisons*, Nordic Innovation Centre, Oslo.
5. Dean, J. (1950), 'Pricing Policies for New Products', *Harvard Business Review*, Vol. 28 No. 6, pp. 45-53.
6. Golder, P.N., and Tellis, G.J. (2004), 'Growing, Growing, Gone: Cascades, Diffusion and Turning Points in the Product Life Cycle', *Marketing Science*, Vol. 23 No. 2, pp. 207-218.
7. Halkier, H., Dahlström, M., James, L., Manniche, J., and Smed Olsen, L. (eds.) (2010), *Knowledge Dynamics, Regional Development and Public Policy*, Department of History, International and Social Studies, Aalborg University, Ålborg.
8. Markusen, A.R., Hall, P., and Glasmeier, A. (1986), *High-tech America: The What, How, Where and Why of the Sunrise Industries*, Allen & Unwin, Boston.
9. Schutjens, V., and Stam, E. (2003), 'The Evolution and Nature of Young Firm Networks: A Longitudinal Perspective', *Small Business Economics*, Vol. 21 No. 2, pp. 115-134.
10. Storey, D.J. (2003), 'Entrepreneurship, Small and Medium Sized Enterprises and Public Policy', in Acs, Z.J., and Audretsch, D.B. (eds.), Handbook of Entrepreneurship Research, Dordrecht, pp. 473-511.
11. Strambach, S. (2008), 'Knowledge-Intensive Business Services (KIBS) as Drivers of Multilevel Knowledge Dynamics', *International Journal of Services Technology and Management*, Vol. 10 No. 2, pp. 152-174.
12. Yin, R.K. (1989), *Case Study Research: Design and Methods*, Sage Publications, Beverly Hills.

Harri Jokela is a Researcher at the Oulu Southern Institute at the University of Oulu. He has an MSc in Agriculture and Forestry. His primary interest areas are the development of micro-companies and small- and medium-sized enterprises (SMEs) in rural areas and regional development. In recent years, he has been involved in many projects in the area of regional development.

Eija-Riitta Niinikoski is a Development Manager at the Oulu Southern Institute at the University of Oulu. She has an MA in Theology. Her primary interest areas are regional development, the role of higher education institutions in regional development, internationalization processes and the development of micro companies and SMEs in rural areas and the management and leadership of expert organizations. Niinikoski has been responsible for many development projects; she has also been involved in several international projects.

Dr Matti Muhos is a Research Director at the Oulu Southern Institute at the University of Oulu. He has a Doctoral degree in Industrial Engineering and Management, and he participates in the editorial processes of several international journals. His primary research areas are growth and internationalization of technology-intensive SMEs, including configurations and management viewpoints, development of micro-companies and SMEs, technology-intensive companies, agility, internationalization processes for SMEs and technology management. Muhos has worked on several international projects and has written over 60 publications in the form of journal articles, book contributions, refereed conference papers and technical papers.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

CONSTRUCTION OF KNOWLEDGE CREATION: A CONCEPTUAL FRAMEWORK

Khalid Abdul Wahid, Faculty of Business Administration, Kasetsart University, Bangkok.
karndedkul.m@gmail.com

Haruthai Numprasertchai, Faculty of Business Administration, Kasetsart University, Bangkok.
fbushrp@ku.ac.th

Yuraporn Sudharatna, Faculty of Business Administration, Kasetsart University, Bangkok.
fbusyps@ku.ac.th

ABSTRACT

In knowledge-based economy, continuous innovation is the key to sustainable competitive advantage. Innovation can strengthen the sustainable growth and productivity of a country and increase national productivity as well in the global market through creation of new ideas and opportunities. Innovation is extremely dependent on the availability of knowledge, therefore the complexity created by the explosion of richness and reach of knowledge has to be identified and managed to ensure successful knowledge creation. The purpose of this paper is to construct a knowledge creation framework. A further study will be undertaken using this constructed framework for collecting and analysing data. The framework shows that knowledge creation is influenced by organizational knowledge and market knowledge. Organizational knowledge always becomes obsolete and it should be updated by market knowledge and new created knowledge via technological advancement in order to maintain its up-to-date information.

Keywords: Organizational Knowledge, Market Knowledge, Knowledge Creation

INTRODUCTION

Today market is very dynamic and very high competitive. The market preferences are changing all the time. An organization has to know the market tendencies in order to compete in a very fragile environment. Nonaka and Tekeuchi (1996) stated that in today economy where the only certainty is uncertainty, where competitors grow more and more, customers' preferences are changing and technology develops quickly. Hence, knowledge becomes the source of competitive advantage. Management scholars agree that knowledge has emerged as the critical resource. However, knowledge is not something new, it has been used and exchanged within organizations. Therefore, organizations have to recognize, understand and manage it effectively and efficiently in order to transform that knowledge to become the source of competitive advantage and convert it to be tangible assets of organizations (Davenport & Prusak, 1997).

Davenport and Prusak (1997, p.5) defined knowledge as ‘‘a flux mix of framed experience, values, contextual information, and expert insights providing a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knower. In organizations, knowledge often becomes embedded not only in explicit form, documents or repositories, but also embedded in individual. Thus, knowledge derives from individuals' experiences, values, beliefs, attitudes, and memory that define the individual's know-how within an organization. Knowledge is invisible and intangible, and thus it is not captured very well by any of the traditional techniques that corporations master in their everyday operations. However, scholars are still debating about definition of knowledge and where it belongs to (Stenmark, Winter 2000-2001; Nonaka and Takeuchi, 1996). Tsoukas and Vladimirou (2001) give a picture of knowledge more realistic. They define knowledge is a transformation of individual distinction into actions within a context and it becomes a distinctive production factor that has a huge impact on productivity, innovation, and product development. Thus, many organizations are practising knowledge management to discover new knowledge internally and externally to sustain their competitiveness in the market and make it as a critical source of product input and innovation.

KNOWLEDGE MANAGEMENT

Knowledge management (KM) becomes a hot issue of today business and those who are ignoring this aspect will be left behind (Drucker, 1999). Knowledge management significantly influences strategy formulation and implementation (Grant, 1996a; Zander and Kogut, 1995). Whilst the literature reveals a diverse range of knowledge management definitions and perspectives (Brown and Duguid, 2000; Grant, 1996b; Spender, 1996b), the acknowledged generic management intention is to improve the ‘‘wisdom’’ of the organization to enable improved decision making, and increase innovation, performance, and sustainable competitiveness outcomes (Nonaka and Takeuchi, 1996; Davenport and Prusak, 1997). KM and related strategy concepts are promoted as important and necessary components for organizations to survive and maintain their competitive keenness. It has become necessary for managers and executives to address KM (Goodman & Chinowasky, 1997). KM is considered a prerequisite for higher productivity and flexibility in both the private and the public sectors.

Knowledge management is a necessity due to changes in the environment such as increasing globalization of competition, speed of information and knowledge aging, dynamics of both product and process innovations, and competition through buyer markets (Day, 1994). It promises to help companies to be faster, more efficient, or more innovative than the competition. Also, the term ‘‘management’’ implies that knowledge management deals with the interactions between the organization and the environment and the ability of the organization to react and act (Nonaka & Toyama, 2003). This is particularly true in knowledge-intensive work such as the design and development of products, where knowledge is both a key ingredient as well as a key outcome of the work. Product differentiation requires the rigorous application of theoretical and practical knowledge from various sources, and for this reason the proper management of knowledge can influence the results significantly.

KNOWLEDGE BASED VIEW OF KNOWLEDGE CREATION

The resource-based view (RBV) regards knowledge as a vital organizational resource (Barney, 1991). Organizations that are aware of their knowledge resources possess a valuable, unique resource that is difficult to imitate and can be exploited to achieve a sustainable competitive advantage (Alavi & Leidner, 2003). However, Nonaka & Toyama (2003) argued that RBV ignores the aspect of market knowledge. According to the dialectic knowledge creation, an organization is full of contradiction within and outside firm. Hence, an organization should find a mechanism to balance it but not to control it (Nonaka & Toyama, 2003; Takeuchi & Nonaka, 2004).

Knowledge-based view (KBV) aims at developing a comprehensive view of knowledge that could shed light on organizational creativity, learning, innovation, and change (Nonaka & Krogh, 2009). The existing research suggests that knowledge creation has strong implications for the development of organizational competitive advantage. For example, researchers such as Nonaka and Takeuchi (1996), Ravichandran and Rai (2003) indicate that individuals' abilities to generate new knowledge constitute increasingly rare and socially complex capabilities that contribute to competitive advantage of an organization over its competitors. This notion is supported by other research findings suggesting that successful knowledge creation and implementation will help improve the efficiency and effectiveness of organizational operations (Coff, 2003).

KBV is a contemporary approach to strategic management that guides attention toward the understanding of the management of an organization's core knowledge (Ling, Liau, & Hsing, 2005). Organizational knowledge and related organizational learning processes, such as knowledge creation, represent the core elements of innovative organizations (Inkpen & Tsang, 2005). Knowledge has become the most important strategic input and valuable asset for innovation activities, playing a prominent role in the development of innovative organizations (Nonaka & Teece, 2001). According to KBV, knowledge is continually renewed and replenished (Brown & Eisenhardt, 1997).

The knowledge-creation process starts with socialization where the tacit knowledge of customers and competitors is acquired through field building. That knowledge is then externalized through dialog into explicit knowledge to be shared within an organization. Next, the explicit knowledge is in a form appropriate to be diffused throughout the organization and combined with other existing knowledge. Subsequently, an organization's workers internalize these complex sets of explicit knowledge, and then determine the most favourable application to be put in action. Thus, when an organization is considered a source of knowledge creation, the promotion of the knowledge-creation process expressed by the SECI model becomes an important part of the organization's strategic management. Organizational knowledge is created and restructured in an upward spiral—beginning at the individual level, then moving up to the group level, and finally to the organizational level (Nonaka & Teakeuchi, 1996; Nonaka & Krogh, 2009). This spiral process takes place both intra-organizationally and inter-organizationally as knowledge is transferred beyond organizational boundaries and knowledge from different organizations interacts to create new knowledge. According to Sanchez (2005, p. 28), management must therefore "create broadly based knowledge sharing and learning processes that stimulate and draw on the learning of all individuals and groups in generating the best possible flow of new ideas for their

organizations". According to the knowledge-based view, a firm's primary purpose is the integration of knowledge, and the creation and deployment of dynamic capabilities (Grant, 1996a).

SOURCES OF NEW KNOWLEDGE

The introduction of new products and services is a critical issue of organizational performance and survival (Damanpour, 1991). By introducing new products and services, organizations can establish new markets and technologies (Burgelman, 1991) and adapt and change to meet new market demands (Brown & Eisenhardt, 1995). Hargadon and Fanelli (2002) have divided sources of knowledge into two streams; organizational knowledge which is static and market knowledge which is dynamic.

1. Organizational Knowledge

Organizational knowledge becomes an important factor for knowledge creation (Park, Ribiere, & Schulte Jr, 2004). It is defined as the capability members of an organization have developed to draw distinctions in the process of carrying out their work by enacting sets of generalizations based on collective understandings and experiences (Tsoukas & Vladimirou, 2001). The internal created knowledge can develop new skills, ideas and uniqueness, and difficult for competitors to imitate (Nonaka & Teakeuchi, 1996). Thus, the creation of new knowledge is essential for the success of organizations competing in dynamic environments (Kogut and Zander, 1992). Hedlund and Nonaka (1993) highlight that creating and exploiting knowledge within an organization revolves around the integration of tacit and explicit knowledge and the transfer and transformation of knowledge between internal organization knowledge and market knowledge. Thus, organizations have to adapt the market knowledge and transform it to become organizational knowledge.

The primary source of organizational knowledge is organizational culture, employees' knowledge, procedures and information technology that comprise a firm's climate that informally, and perhaps tacitly, define how the firm is to develop and use knowledge which in turn will affect the creation of new knowledge (Wang, Su, & Yang, 2011, Tsoukas & Vladimirou, 2001).

1.1 Organizational Culture

The concept of organizational culture began seriously in the 1980s (Cameron & Quinn, 2006). They argue that organizations have taken for granted and ignore organizational culture as an important factor. Many researchers have argued that organizational performance has a positive relation with organizational culture (DeLong and Fahey, 2000). Organizational behaviour is determined more by its culture than directives from senior management and the implementation of strategies in many organizations is affected if they are at odds with the organization's culture (Jarnagin and Slocum, 2007). According to Tsoukas and Vladimirou (2001) find that employees' judgement in diagnosing problems has been crucially shaped by the overall company culture. This makes employees to internalize a set of values which help them shape their actions accordingly.

Organizational culture is an important issue in both academic research and management practice because it is the most important factor that can make the organization succeed or fail (Schein, 2004). Culture might be one of the strongest and most stable strength within the organizational context (Schein, 2004). According to Schein (2004), organizational culture is the most critical factor controlling an organization's capacity, effectiveness, survival and success. Schein (2004) defines organizational culture as a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems. This definition gives a reason why the culture is important in the success of the operations and activities of the organization.

Many studies proposed that organizational culture can play a key role in supporting or hindering successful application of knowledge creation (Rhodes, Hung, Lok, Lien, & Wu, 2008). A study conducted by Al-Adaileh & Al-Atawi (2011) to investigate the impact of organizational culture on the knowledge creation process in the Saudi Telecom Company (STC) has a statiscally significance.

1.2 Employees' Knowledge

Many philosohers ackknowledged that there are two types of knowledge in organization; tacit and explicit knowledge (Davenport & Prusak, 1997; Nanaka & Krogh, 2009; Nonaka & Teakeuchi, 1996; Nonaka & Teece, 2001). The debate among those philosophers is on whether tacit knowledge is inidivual essence or organizational knowledge. However, Tsoukas & Vladimirou (2001) do not make any differences for both types of knowledge. They argued that both types of knowledge are necessary for organizational knowledge.

Tacit knowledge is knowledge that cannot be easily captured by any information system. It only exists in people's hands and minds, and manifests itself through their actions. Therefore, tacit knowledge has drawn the interest from many knowledge management researchers. Stenmark (Winter, 2000-2001) suggested that an organization should observe and recognize it through the actions instead of identify, capture and make it explicit.

The tacit knowledge of employees should be reflective in the form of actions so that the process of knowledge creation will happen. In other words, it is a process of internalization which is mentioned by Nonaka (1995) in the knowledge creation spiral. Tsoukas & Vladimirou (2001) suggest that in order to make employees' tacit knowledge reflective, an organization should have some mechanism such as training, supervision, and knowledge sharing among employess.

Employees need to develop their skills in order to become effective in their job. The required skills can be developed through training. Once, employees a develop a set of diagnostic skills which over time become instrumentalized tacit (Tsoukas & Vladimirou, 2001). This enables them to think quickly and effectively. According SECI, training is a process of internalization in knowledge creation process (Nonaka, Toyoma, & Konno, 2000). Internalization is the process of embodying explicit knowledge into tacit knowledge. Through internalization, explicit knowledge created is shared throughout an organization and converted into tacit knowledge by individuals. Training programs can help trainees to understand an organization

and themselves. By reading documents or manuals about their jobs and the organization, and by reflecting upon them, trainees can internalize the explicit knowledge and will enrich their tacit knowledge. When knowledge is internalized to become part of individuals' tacit knowledge bases in the form of shared mental models or technical know-how, it becomes a valuable asset.

1.3 Organizational Routines

Besides the employees' skills and experience. An organization needs a wirtten procedure, tacit knowledge, to be a guidline for effective work and good quality output. Employees will refer to the written procedures or manual in completing their tasks and jobs. A study conducted by Tsoukas & Vladimirou (2001) on customer operators in Patafon shows that wirtten manuals provide information for the operators on going issues and current network problems. This makes operators can handle customers queries. Operators mostly agreed that most of the knowledge contains in company's manuals. This type of knowledge will make employess doing their tasks for efficeintly and effectively. The written manual is stored in an organization's memory in the form of tacit knowledge.

Written Manual and procedures also become an integrating mechanism of an organizational knowledge cross-functional collaboration. A study undertaken by Sobek, Loker and Ward (1998) found that Toyota established coordinating mechanisms, including standardized reporting, and documentation, formalized work processes, problem-solving meetings. Integration among its different units. Those written procedures were also adopted by Southwest and BMW to integrate the knowledge among members of their cross-functional teams (BusinessWeek, 2006).

1.4 Technological System

The delevolpment of sophisticated corporate information system makes an organization to retrieve needed information very quickly and on time. This system is very important especially in service providing organization such as telephone operator department. Any delay in response to customers will make customers dissatrisfied with the service. Tsoukas & Vladimirou (2001) found that telephone operators will retreive customers' profile very quickly. Ideally, an organizational member will have all information they needed. Without a solid IT infrastructure, an organization cannot enable its employees to share information on a large scale. Yet the trap that most organizations fall into is not a lack of IT, but rather too much focus on IT.

Information technological system becomes one of the critical success factors in implementing knowledge management (Hasnali, 2002). The study shows that ICT has a significant positive influence on the processes of knowledge creation (Lopez-Nicolas & Soto-Acosta, 2010). The study in small innovative hi-tech firms shows that the use of IT assists in creating new knowledge (Spraggon & Bodolica, 2008). IT represents a valuable tool where individual, group and organizational knowledge is continuously codified, stored, diffused and renewed. It also represents a significant source of organizational learning and knowledge creation.

The study of Yang, Chen and Wang (2012) on the impacts of information technology on knowledge management practice in construction industry shows that levels of IT application

are positively associated with projects' levels of knowledge management. Additionally, project outcomes can be achieved with higher levels of knowledge management. The findings also indicate IT application affects on project performance in terms of schedule and cost success as well as quality and safety performance.

2. Market Knowledge

In general, there are two basic sources of knowledge. The first appears when firm conducts learning with unexplored with an organization, which is called internal source. Second, an organization explores new knowledge from outside an organization which comes from external source (Nonaka & Teakeuchi, 1996). According to knowledge based view of the firm, external knowledge acquisition from market environment becomes one of the critical means for knowledge creation in order to achieve competitive advantage (Nonaka & Teakeuchi, 1996). In this study we refer external knowledge as market knowledge. Market knowledge is not explicit but rather than difficult to codify and communicate (Nonaka,1995).The prior research shows that the acquisition of market knowledge leads to short-term improvements in sales and profitability growth, market share, new product success, customer satisfaction and return on assets (Slater & Narver, 1994).Outside sources of knowledge are critical to the innovation process in general (Cohen and Levinthal, 1990) and in particular in the context of changing knowledge environments. Organizations can acquire information and knowledge from their interactions with a variety of external sources which includes customers and competitors (Day, 1994). The advantages of market knowledge acquisition are worthwhile since dynamic environments may cause obsolescence in firm's current knowledge and capabilities (Nonaka, 1995). The ability to capture market knowledge leads to active acquisition and distribution of the needs and responses of the market, the position of competitors and customer preferences (Day, 1994). This implies that an organization that correctly identifies, collects, and uses information about customer and competitor conditions is deemed to be knowledgeable about the market.

Knowledge and capability value can be eroded by external changes (Collins, 1994). Thus, it is the environment, through opportunities and threats, which determines the real value of organizational knowledge (Priem and Butler, 2001). Therefore, if supply-side, demand-side or macroeconomic factors change, then knowledge value also may vary. As Nonaka (1995) points out that any organization that dynamically deals with a changing environment ought not only to process information efficiently but also create information and knowledge. An organization needs to continually acquire new market knowledge as the seeds for future market development. The inability to respond to market changes quickly makes an organization hard to survive in the competitive world (Kumar, Jones, Venkatesan, & Leone, 2011). Therefore, it is critical for managers to identify and understand market changes in order to sustain performance. De Geus (1988) pointed out that the sustainable advantage of an organization is its ability to learn and anticipate market trends faster than its competitors.

The organizational knowledge is useful at a certain period of time when market environment changes, it needs to acquire and create new knowledge in order to update the existing knowledge within an organization and to sustain the competitive advantage (Nonaka & Teakeuchi, 1996). Thus, they enable an organization to build a value-creating strategy (Barney, 1991). Moreover, when organizational capabilities are embedded in firm's tacit and

collective knowledge, the factor market threats of imitation, substitution, dissipation and appropriation may decrease (Barney, 1991).
The determining factors in the dynamic market environment are customers and business partners including competitors (Day, 1994). A study by Belkahla and Triki (2011) found that organizations perceive employees as corporate knowledge, meanwhile customers and competitors are market knowledge and become sources of competitive advantage in creating new knowledge.

2.1 Customer Knowledge

The voice of the customer is deployed throughout the product planning and design stages (Franceschini and Rossetto, 2002). It will become an input in the product design and development (Zairi and Youssef, 1998). Any changes in customers' demands may negatively affect the value of current marketing capabilities. The literature suggests that the primary objective of an organization is to deliver superior customer value, which is based on knowledge gathered from customer analyses and disseminated throughout the organization (Narver & Slater, 1990). The understanding of customer needs, preferences and market trends enables the organization to identify and develop capabilities for long term performance (Day, 1994) because the organization has information on customers' implicit needs to fulfill customers' satisfaction.

The collection of customer needs and preference can be done by incorporating customer's voice into every aspect of the organization's activities and rapid sharing and disseminating the knowledge of the organization's customers. The sharing of this information within an organization makes the firm well positioned to develop organizational memory (Kumar, Jones, Venkatesan, & Leone, 2011).

2.2 Competitor Knowledge

A considerable body of marketing thought suggests that competitor knowledge should improve an organization's performance by enabling the firm to position its strengths against rivals' weaknesses (Slater & Narver, 1994). Besides, customers' implicit needs and preferences, an organization also needs to analyze competitors' strength, weaknesses, capability and strategy in order to sustain competitiveness in the market. This rivalry view is also shared by prominent theorists in management and economics, who argue that an organization's performance largely depends on its ability to "beat the competition" either by manipulating an industry's structural parameters, as in competitive forces theory (Porter, 1980), or by developing difficult-to-imitate competencies, as in the resource-based perspective (Barney 1991). Specific competitor knowledge may result from an in-depth analysis of the behavior, products, and strategies (De Luca & Atuahene-Gima, 2007).

However, some researchers viewed that the rivalry is not the only approach to gather competitor knowledge (Luo, Rindfleisch, & Tse, 2007). They argued that alliances with competitors are another approach to create market knowledge. For example, Sony, IBM, and Toshiba are co-developing the cell chip to serve as the brains of the PlayStation 3 console (BusinessWeek, 2005).

To sum up, environmental dynamism may cause obsolescence in firm's current knowledge base, eroding its competitive advantage (O'Reilly & Tushman, 2008). To avoid this damage, organizations need to carry out an explorative learning that enables them to reconfigure their capabilities base (Lavie, 2006). Thus, market knowledge acquisition by firms may be considered as a key element for explorative learning development (Lavie, 2006). Therefore, any organization which deals with changing environment efficiently, it will create new knowledge as a source of competitive advantage.

NEW KNOWLEDGE

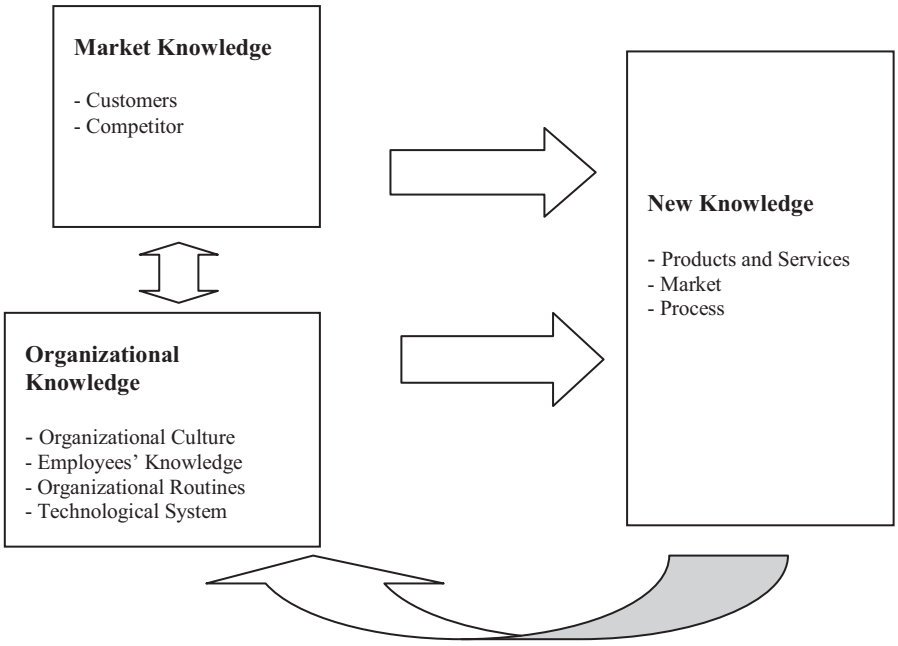
An organization can develop value and potential to sustain competitive advantage by creating knowledge (Bryant, 2005). Spender (1996a) emphasizes the importance of knowledge creation in knowledge-based views of the organization. He holds that there are two predominant goals of organization which are the generation and application of knowledge. Tsoukas and Mylonopoulos (2004) noted that an organization that has the ability to create knowledge develops a capability that is dynamic and unique and that potentially underpins continuous organizational learning. This is supported by empirical findings that knowledge creation is critical to a range of organizational processes supporting competitive advantage, including new product development and dynamic capability evolution (Smith, Collins, & Clark, 2005).

According to KBV, knowledge creation is a synthesizing process between organizational knowledge and market knowledge (Nonaka & Toyama, 2003; Takeuchi & Nonaka, 2004). The processes involved in knowledge creation are not only organization-specific, but also socially complex (Coff, 2003). KBV argues that RBV fails to capture the dynamic process through which organizational members interact with the environment (Nonaka & Toyama, 2003). Knowledge should be viewed from different angles through environmental interaction and externalization of personal knowledge. An organization will create new knowledge by assimilating and integrating organizational knowledge and market knowledge (Nonaka & Toyama, 2003; Takeuchi & Nonaka, 2004). Knowledge is produced through the synergy of four activities: problem solving, implementing and integrating, experimenting, and importing knowledge (Leonard & Sensiper, 1998). According to KBV, the knowledge creation is a spiral process. The organizational knowledge will be updated when there is new information or the market environment changes (Takeuchi & Nonaka, 2004). Therefore, the new created new knowledge will renew the existing knowledge in the organization by the advancement of technology.

There are not many literatures discussing about the dimensions of new knowledge. Most of the literatures discussed new knowledge in the form its tacitness and explicitness. New knowledge may be translated into many forms such as in products or services, in process and in technology (Cooper, 1998). Schumpeter (1934) suggested five dimensions in which new knowledge is translated namely new products and services, new method of production, new markets, new sources of supply and new organizational forms. Miller & Friesen (1983) focused on four dimensions: new product and services, new method of production, risk taking by key executives and seeking solution. While Capon, Farley, Hulbert, & Lehmann (1992) suggested three dimensions: market, strategic tendency to pioneer and technological advancement. Wang and Ahmed (2004) suggested five dimensions of new knowledge; products and services, market, process, behaviour and strategy. We decided to take

dimensions introduced by Wang and Ahmed (2004) in our framework. However, this framework excludes strategy because it is still debateable among researchers (Wang & Ahmed, 2004).

Figure 1 The Framework of Knowledge Creation



1. Products and Services Outcome

Innovative products and services present an opportunity for business expansion and success (Henard & Szymanski, 2001). New knowledge in products and services allow companies to establish dominant position in the competitive marketplace, and afford new entrants an opportunity to gain a foothold in the market (Danneels & Kleinschmidt, 2001). New knowledge is crucial to new product creativities (Yang, 2007). Innovation, which harnesses new knowledge or reconfigures existing knowledge, can yield new ideas and products (Grant, 1996a), while at the same time yielding projects competent to the customers (Rastogi, 2002).

2. Market Outcome

Market is highly related to new product, and often studied as product-market innovativeness (Schumpeter, 1934; Cooper, 1973; Miller, 1983). New knowledge of market refers to the discovery of new market which is related to market research, advertising and promotion (Andrews and Smith, 1996), as well as identification of new market opportunities and entry into new markets (Ali, Krapfel, & Labahn, 1995). They can enter a market or identify a new market niche and launch products with cutting-edge technological content.

3. Process Outcome

The discovery of new knowledge can lead to process innovativeness which captures the introduction of new production methods, new management approaches and new technology

that can be used to improve production and management process (Wang & Ahmed, 2004). Process outcome is mainly driven by the needs of production and can be said to be primarily efficiency-driven (Bergfors & Larsson, 2009). As a result, an organization can exploit their resources and recombine its resources for optimizing the competitive advantage in production. Besides the implementation of new approach, new process also can lead to the reduction of production costs, higher production yields, improvement of production volumes and product recoveries and environment-friendly production (Lager, 2002).

CONCLUSION

In today fast changing business world, innovation has become the mainstay of every organization. The nature of global economic growth has been changed by the speed of innovation, which has been made possible by rapidly evolving technology, shorter product lifecycles and a higher rate of new product development. Organizations have to ensure that their business strategies are innovative to build and sustain competitive advantage. Innovation is a capacity to move beyond current ways of doing things and current ways of operating companies to move beyond the best practice to shape best practice Innovation can strengthen the sustainable growth and productivity of a country and increase national productivity as well in the global market through creation of new ideas and opportunities.

Innovation has, however, become increasingly complex due to changing customer needs, extensive competitive pressure and rapid technological change. The complexity of innovation has also been increased by growth in the amount of knowledge available to organizations as basis for innovation. It is extremely dependent on the availability of knowledge and therefore the complexity created by the explosion of richness and reach of knowledge has to be identified and managed to ensure successful innovation**.** Knowledge as embodied in human capital becomes a central to economic development. There is a reason to believe that the nature of the organizational knowledge and market knowledge have an effect on organization's growth.

BIBLIOGRAPHY

1. Al-Adaileh, R., & Al-Atawi, M. (2011). Organizational culture impact on knowledge exchange: Saudi telecom context. *Journal of Knowledge Management , 15* (2), 212-230.
2. Alavi, M., & Leidner, D. (2003). Virtual learning system. *Encyclopedia of Information System , 4*, 561-572.
3. Ali, A., Krapfel, R. J., & Labahn, D. (1995). Product innovativeness and entry strategy: impact on cycle time and break-even time. *Journal of Product Innovation Management , 12* (1), 54-70.
4. Andrews, J., & Smith, D. (1996). In search of marketing imagination: factors affecting the creativity of marketing programs for mature products. *Journal of Marketing Research , 33*, 17-37.
5. Barney, J. (1991). Firm resources and sustainable competitive advantage. *Journal of Management , 17* (1), 99-120.
6. Belkahla, W., & Tirki, A. (2011). Customer knowledge enabled innovation capability: proposing a measurement scale. *Journal of Knowledge Management , 5* (4), 648-674.

7. Bergfors, M., & Larsson, A. (2009). Product and process innovation in process industry: a new perspective on development. *Journal of Strategy and Management , 2* (3), 261-276.
8. Brown, J., & Duguid, P. (2000). *The Social Life of Information.* Boston, MA: Harvard Business School Press.
9. Brown, J., & Eisenhardt, K. (1997). The art of continous change: linking complexity theory and time pace-evolution in relentlessly shifting organizations. *Administrative Science Quarterly , 42* (1), 1-34.
10. Bryant, S. (2005). The impact of peer mentoring on organizational knowledge creation and sharing: an empirical study in a software firm. *Group and Organization Management , 30* (3), 319-338.
11. Burgelman, R. (1991). Intraorganizational ecology of strategy making and organizational adaptation: theory and field research. *Organizational Science , 2*, 239-262.
12. BusinessWeek. (2005, February 14). IBM Discovers the Power of One. p. 80.
13. BusinessWeek. (2006, April 24). The world's most innovative companies. *BusinessWeek* , pp. 63-74.
14. Cameran, K., & Quinn, R. (2006). *Diagnosing and Changing Organizational Culture: Based on the Competibg Values Framework* (Revised ed.). Reading, MA: Addison Wesley.
15. Capon, N., Farley, J., Hulbert, J., & Lehmann, D. (1992). Profiles of product innovators among large US manufacturers. *Management Science , 38* (February), 157-169.
16. Coff, R. (2003). The emergent knowledge-based theory of competitive advantage: an evolutionary approach to integrating economics and management. *Managerial and Decision Economics , 24*, 245-251.
17. Cohen, W., & Lavinthal, D. (1990). Absortive capacity-a new perspective on learning and innovation. *Administrative Science Quarterly , 35*, 128-152.
18. Collins, D. (1994). Research note: how valuable are organizational capabilities? *Strategic Management Journal , 15* (Special Issue), 143-152.
19. Cooper, J. (1998). A multidimentional approach to the adoption of innovation. *Management Science , 36* (8), 493-502.
20. Damanpour, F. (1991). Organizational innovation: a meta analysis of effects of determinants and moderators. *Academy of Management Journal , 34*, 555-590.
21. Danneels, E., & Kleinschmidt, E. (2001). Product innovativeness from the firm's persepctive: its dimensions adn their relation with product selection and performance. *The Journal of Product Innovation Management , 18* (6), 357-373.
22. Davenport, T., & Prusak, L. (1997). *Working Knowledge: How Organizations Manage What They Know.* Boston: Harvard Business School Press.
23. Day, G. (1994). The capabilities of market-driven organizations. *Journal of Marketing , 58* (October), 37-52.
24. De Geus, A. P. (1988). Planning as learning. *Harvard Business Review , 66* (March-April), 70-74.
25. De Luca, L. M., & Atuahene-Gima, K. (2007). Market knowledge dimensions and cross-functional collaboration: examining the different routes to product innovation performance. *Journal of Marketing , 71* (January), 95-112.
26. DeLong, D., & Fahey, L. (2000). Diagnosing cultural barriers to knowledge. *Academy of Management Executive , 14* (4), 113-127.
27. Drucker, P. (1999). *Management Challenges for the 21st Century.* New York: Harper Business.

28. Franceschini, F., & Rossetto, S. (2002). QFD: an interactive algorithm for the prioritization of product's techncal design characteristics. *Intergrated Manufacturing Systems , 13* (1), 63-75.
29. Goodman, R., & Chinowasky, P. (1997). Preparing construction professionals for executive decision making. *Journal of Management in Engineering , 13* (6), 55-61.
30. Grant, R. (1996a). Prospering in dynamically-competitive environment: organizational capability as knowledge integration. *Organization Science , 7*, 376-387.
31. Grant, R. (1996b). Toward a knowledge-based theory of the firm. *Strategic Management Journal , 17* (Winter Special Issue), 109-122.
32. Hargadon, A., & Fanelli, A. (2002). Action and possibility: reconciling dual perspectives of knowledge in organizations. *Organization Science , 13*, 290-302.
33. Hasnali, F. (2002). Critical success factors of knowledge management. *APQC* , 1-4.
34. Hedlund, G., & Nonaka, I. (2008). Models of knowledge management in the West and Japan. In P. Lorange, *Implementing Strategic Process: Change, Learning and Cooperation.* Oxford: Basil Blackwell.
35. Henard, D., & Szymanski, D. (2001). Why some new products are more successful than others. *Journal of Marketing Research , 38* (3), 362-375.
36. Inkpen, A., & Tsang, E. (2005). Social Capital, networks and knowledge transfer. *Academy of Management Review , 30* (1), 146-165.
37. Jarnagin, C., & Slocum, J. (2007). Creating corporate cultures through mythopoetic leadership. *Organizational Dynamics , 36* (3), 288-302.
38. Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities and the replication of technology. *Organization Science , 3* (3), 383-397.
39. Kumar, V., Jones, E., Venkatesan, R., & Leone, R. (2011). Is market orientation a source of sustainable competiyive advantage or simply the cost of competing. *Journal of Marketing , 75* (January 2011), 16-30.
40. Lager, T. (2002). A structural analysis of process development in process industry: a new classification system for strategic project selection and portfolio balancing. *R&D Management , 32* (1), 87-95.
41. Lavie, D. (2006). Capability reconfiguration: an analysis of incumbent responses to technological change. *Academy of Management Review , 31* (1), 153-174.
42. Leonard, D., & Sensiper, S. (1998). The role of tacit knowledge in group innovation. *California Management Review , 40* (3), 112-132.
43. Ling, K., Liau, S., & Hsing, W. (2005). The high-tech milieuand innovation oriented development. *Technovation , 25* (2), 145-153.
44. Lopez-Nicolas, C., & Soto-Acosta, P. (2010). Analyzing ICT adoption and use effects on knowledge creation: an empirical investigation in SMEs. *International Journal of Information Management , 30*, 521-528.
45. Luo, X., Rindfleisch, A., & Tse, D. (2007). Working with rivals: the impact of competitor alliances on financial performance. *Journal of Marketing Research , XLIV* (February), 73-83.
46. Miller, D., & Friesen, P. (1983). Strategy-making and environment: the third link. *Strategic Management Journal , 4* (3), 221-235.
47. Narver, J., & Slater, S. (1990). The effect of amarket orientation on business performance. *Journal of Marketing , 54* (October), 20-35.
48. Nonaka, I. (1995). The knowledge creating company. *International Journal of Knowledge Management* , 122-123.

49. Nonaka, I., & Krogh, G. (2009). Tacit knowledge and knowledge conversion: controversy and advancement in organizational knowledge creation theory. *Organizational Science , 20* (3), 635-652.
50. Nonaka, I., & Teakeuchi, H. (1996). A theory of organizational knowledge creation. *International Journal of Technology Management , 11*, 833-846.
51. Nonaka, I., & Teece, D. (2001). *Managing Industrial Knowledge: Creation, Transfer, and Utilization.* London: Sage Publication.
52. Nonaka, I., & Toyama, R. (2003). The knowledge-creating theory revisited: knowledge creation as a synthesizing process. *Knowledge Management Research and Practice , 1*, 2-10.
53. Nonaka, I., Toyoma, T., & Konno, N. (2000). SECI, Ba and leadership: a unified model of dynamic knowledge creation. *Long Range Planning , 33*, 5-34.
54. O'Reilly, C., & Tushman, M. (2008). Ambidexterity as a dynamic capability: resolving innovator's delemma. *Research in Organizational Behaviour , 28*, 185-206.
55. Park, H., Ribiere, V., & Schulte Jr., W. (2004). Critical attributes of organizational culture that promote knowledge management technology implementation success. *Journal of Knowledge Management , 8* (3), 106-117.
56. Porter, M. (1980). *Corporate Strategy.* New York: The Free Press.
57. Priem, R., & Butler, J. (2001). Is the resource-based view a useful perspective for strategic management research? *Academy of Management Review , 26* (1), 22-40.
58. Rastogi, P. (2002). Knowledge management and intellectual capital as paradigm of value creation. *Human Systems Management , 21* (4), 229-240.
59. Ravinchandran, T., & Rai, A. (2003). Structural analysis of the impact of knowledge creation and knowledge embedding on software process capability. *IEEE Transactions on Engineering Management , 50*, 270-284.
60. Rhodes, J., Hung, R., Lok, P., Lien, B., & Wu, C. (2008). Factors influencing organizational knowledge transfer: implication for corporate performance. *Journal of Knowledge Management , 12* (3), 84-100.
61. Sanchez, R. (2005). *Knowledge Management and Organizational Learning: Fundamental Concepts for Theory and Practice.* Lund: Lund Institute of Economics.
62. Schein, E. (2004). *Organizational Culture and Leadership.* San Francisco, CA: Jossey-Bass.
63. Schumpeter, J. (1934). *The Theory of Economic Development.* Cambridge, MA.: Harvard University Press.
64. Slater, S., & Narver, J. C. (1994). Does competitive enviroment moderate a market orientation-performance relationship. *Journal of Marketing , 58* (January), 46-55.
65. Smith, K., Collins, C., & Clark, D. (2005). Existing knowledge, knowledge creation and the rate of new product introduction in high-technology firms. *Academy of Management Journal , 48* (2), 346-357.
66. Sobek, D. K., Loker, J. K., & A., W. (1998). Another look at hiw Toyota integrates product development. *Harvard Business Review , 76* (4), 36-49.
67. Spender, J. (1996b). Organizational knowledge, learning and memory: three concepts in search of a theory. *Journal of Organizational Change Management , 9*, 163-179.
68. Spraggon, M., & Bodolica, V. (2008). Knowledge creation processes in small innovative hi-tech firms. *Management Research News , 31* (11), 879-894.
69. Stenmark, D. (Winter 2000-2001). Leveraging tacit organisational knowledge. *Journal of Management Information System , 17* (3), 9-24.

70. Takeuchi, H., & Nonaka, I. (2004). Knowledge creation and dialectics. In H. Takeuchi, & I. Nonaka, *Hitotsubashi on Knowledge Management* (pp. 1-27). Singapore: John Wiley & Sons.
71. Tsoukas, H., & Mylonopoulos, N. (2004). Introduction: knowledge construction and creation in organizations. *British Journal of Management , 15* (1), 1-8.
72. Tsoukas, H., & Vladimirou, E. (2001). What is organizational knowledge. *Journal of Management Studies , 38* (7), 973-993.
73. Wang, D., Su, Z., & Yang, D. (2011). Organizational culture and knowledge creation capability. *Journal of Knowledge Management , 15* (3), 363-373.
74. Wang, L., & Ahmed, P. (2004). The development and validation of the organizational innovativeness construct using confirmatory. *European Journal of Innovation Management , 7* (4), 303-313.
75. Yang, J. (2007). The contingency value of knowledge in new product creativity. *International Journal of Technology Management , 40* (Nos 1/2/3), 101-113.
76. Yang, L., Chen, J., & Wang, H. (2012). Assessing impacts of information technology on project success through knowledge management practice. *Automation in Construction , 22*, 182-191.
77. Zairi, M., & Youssef, M. (1998). Competing through modern qualilty principles: a forward management approach. *International Journal of Technology Management. , 16* (4-6), 291-305.
78. Zander, U., & Kogut, B. (1995). Knowledge and the speed of the transfer and imitation of organisational capabilities: an empirical test. *Organization Science , 6*, 76-92.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

PERSONAL VALUES AND GIFT GIVING: THE CASE OF CHOOSING A RESTAURANT FOR HOSTING DINNER

Peeraya Lekkumporn, Marketing Department, Faculty of Business Administration, Kasetsart University, Thailand
Email: Peeraya.Lekkumporn@gmail.com

ABSTRACT

Learning on how people choosing a product or service remains an attractive topic for marketers for ages; nonetheless, how people utilize their cognitive structure when selecting products or services might be even more interesting. In this study, the cognitive structure of consumers was examined when choosing a restaurant for hosting dinner for their friends or family-members. Consumers' cognitive structure in this study could be seen as the structure of Gift Giving Behaviour (GGB) because choosing a restaurant for others could be seen as gifting. From the literatures of GGB, the eight factors were achieved as the GGB structure: Attitude toward Behaviour (AB), Subjective Norm (SN), Perceived Behavioural Control (PBC), Self-Identity toward Other (SIO), Self-Identity toward Self (SIS), Anticipated Emotion (AE), Purchase-Decision Involvement (PDI) and Symbolic of Gift (SG). Additionally, Personal Value (PV) which has been founded as an influencer for GGB also included in this study as the antecedent of GGB structure.

Accordingly, this study aims to explain the relationship between Personal Value (PV) and Gift Giving Behaviour (GGB). Hosting a dinner for the closed relationship such as friend and family member is employed as a context for this study, so as to restrict GGB for intangible gift, occasional gifting, and with closed relationship. Kahle's List of Value (LOV) was utilized as PVs construct such as Warm Relationship with Others (WR), Self Respect (SR), Self Fulfilment (SF), Sense of Accomplishment (SA), Fun and Enjoyment (FE), Sense of Belonging (SB), Being Well-Respected (BR), Security (SC), and Excitement (EC). Since GGB is one of voluntary behavior which directly related to Theory of Planned Behaviour (TPB), some criteria from TPB were in cooperated. Thus GGB construct consists of nine criteria which three factors were extracted from GGB such as Motivation of GGB (MG), Gift-Selection Effort (GE), Information Searching (IS) and six factors of TPB were included such as Attitude toward Behaviour (AB), Subjective Norm (SN), Perceived Behavioural Control (PBC), Intensity of intention (II), Self-Identity (SI), and Anticipated Emotion (AE). The total of 638 respondents from web-based survey was captured in Australia. Structural Equation Modeling (SEM) was applied as a tool for analysis the data. Regard to the AMOS output, the final model of six PVs and eight GGB factors was accepted. The six PVs were Warm Relationship with Others (WR), Sense of Accomplishment (SA), Sense of Belonging (SB), Being Well-Respected (BR), Security (SC), and Excitement (EC). The eight factors of GGB construct were Attitude toward Behaviour (AB), Subjective Norm (SN), Perceived Behavioural Control (PBC), Self-Identity toward Other (SIO), Self-Identity toward Self (SIS), Purchase-Decision Involvement (PDI) and Symbolic of Gift (SG).The results confirmed the previous study of Beatty, Kahle, and Homer in 1991 that the PVs has influence on GGB. Also it elaborated how each PVs affect differently on each factor of GGB construct. For example, people who held two PVs such as Warm Relationship to Others (WR) and Excitement (EC) as their primary PV tend to choose a gift utilizing Attitude toward Behaviour (AB) more than the

others. This study contributes to both theoretical and managerial perspectives. The relationship of each PVs and each factor of GGB was drawn. As well as the GGB construct was proposed. For marketing managers, the PV-based segmentation could be used for better understanding customers and planning marketing strategy in gift market.

Keyword: Personal Values, Gift giving, Customer psychology, Cognitive Construct,

Consumer Behaviour, Structural Equation Modeling

INTRODUCTION

Gift-Giving Behaviour (GGB) was revealed in anthropology in 1924 by Marcel Mauss's seminal essay (Sherry, 1983). In 1979, the concept of Gift-Giving Behaviour (GGB) was established by Belk (1979) and since then to be continues in the spotlight in various disciplines such as sociology, anthropology, psychology, sociology, ethnography, economics and consumer behaviour. However, a limited number of studies looked at the antecedent of GGB, for example Beatty et al. (1991) who mentioned PV as an antecedent of GGB. Further studies of GGB and personal value (PV), tend to focus on cultural factors, especially in Asian, which personal values in these studies were linked to cultural value such as Japan (S. E. Beatty, Kahle, Utsey, & Keown, 1993; Lotz, Shim, & Gehrt, 2003), Hong Kong (Yau, Chan, & Lau, 1999), Korean (Jackson & Kwon, 2006; Park, 1998), and Chinese (Qian, Razzaque, & Keng, 2007). Therefore, there is a need to explore PV as antecedent of GGB beyond the cultural aspect.

This study aims to investigate the relationship of GGB and PV, particularly for intangible gift. The intangible gift is rarely to be explored in GGB literature (Clarke, 2007, 2008), and thus needs more attention. This study investigates how consumers choose a restaurant for hosting dinner to identify the factors that important for PV and GGB relationship. An interesting result has been found and will be presented overleaf.

The Relationship between Personal Value and Gift Giving Behaviour

Gift-Giving Behaviour (GGB) is an interesting behaviour because of two reasons. It is not only being the unique behaviour that integrates society, but also GGB is a universal behaviour which can happen across the world, no matter what nation or culture. Additionally the antecedents of GGB is very attractive to investigate because it is not a behaviour that the giver would consider only the self, but other situational conditions such as who is the recipient, what is the occasion, and / or how close of relationship between the giver and recipient are also involved in that consideration. Consequently, understanding the antecedent of GGB can lead to be more understanding about the sequential aspects of GGB such as motivation of GGB.

In social science, the main focus of the researchers is on fundamental matter of all aspects of GGB such as component of GGB, perspectives of GGB, function of GGB, and motivation of GGB. Particularly, the motivation of GGB can explain why people buy gifts. This study suggested that the answer underpinning GGB lends itself into two aspects; occasional and spontaneous. In occasional, people buy gift because of occasions, so GGB of this event involves norm or ritual in some extents. Thus, the motivation of GGB in this event can be

located somewhere between voluntary and obligatory continuum proposed by Goodwin, Smith, and Spiggle (1990) depending on values held by the individual. For example, if a person perceives the occasion as a main driver to give gift, such person seems to be forced by ritual or norm as an obligatory for GGB. In contrast, if a person perceives the occasion as an opportunity to express self-concept or self's feeling toward a recipient through the gift, that person tends to give the gift with the real desire or voluntary. However, in practical, such person might be motivated by both obligatory and voluntary motivation in some extents for some situations. In spontaneous, people buy gift with no occasions, so there is no forces from norm or ritual. Hence, the motivation of GGB is seemingly purely coming from the giver's desire which may be seen as voluntary.

Another main matter which is interested by number of consumer researchers is how people buy gifts such as gift-purchasing involvement, effort, brand, channel, and motivation. When people make a real decision for gift-selection, they tend to take one more continuum, not voluntary or obligatory, into their considerations: maximising self-satisfaction, agonistic, and maximising the pleasure of recipient, altruistic (Sherry, 1983). When the giver purchases the gift to reflect predominantly self-concern such as the giver's self-concept, status, and / or preference, the agonistic motivation would be applied. On the other hand, the altruistic motivation would be operated when the giver purchases the gift which predominantly refers to the recipient-concern such as the recipient's taste, status, and / or need. Additionally, the traditional gift which symbol of the particular occasion such as utilitarian gifts for new-wedding couple or chocolates and flowers for Valentine's day might be driven by the norms motivation (Wolfinbarger, 1990). Accordingly, a giver has at least, three choices of motivation to select the gifts; agonistic, altruistic, and norms, and two choices of motivation to give gifts; voluntary and obligatory (see Figure 1). The questions are that when and how each of those motivation or the mixture motivations will be applied.

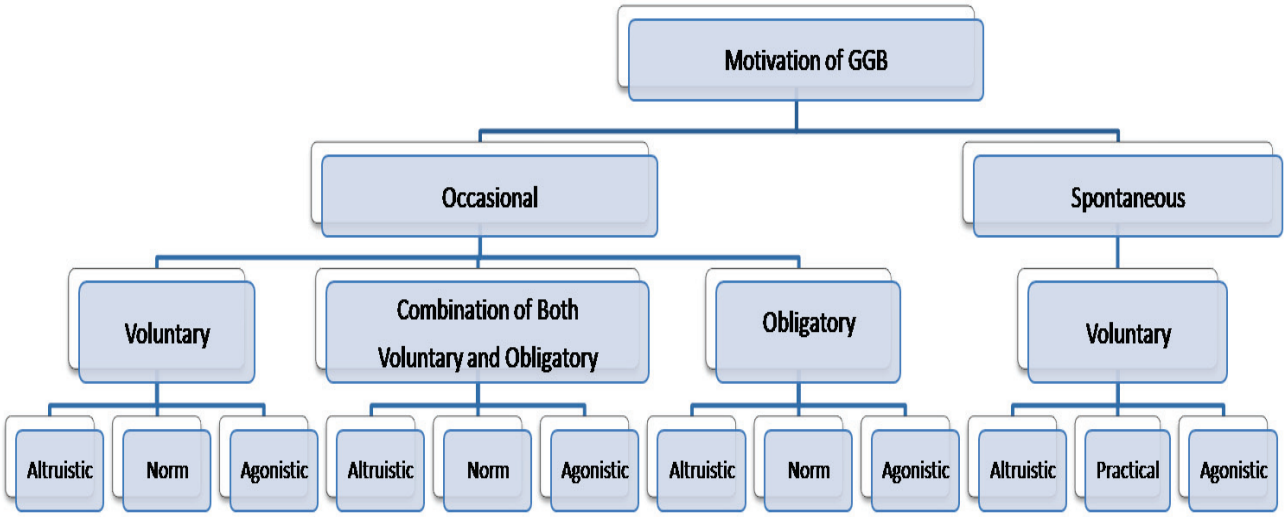


Figure 1: Motivation of GGB
Source: adapted from Goodwin et al., 1990; Sherry, 1983; Wolfinbarger, 1990; Wolfinbarger and Yale, 1993

To fulfil one's values in life, the person can be motivated to engage in particular behaviours such as gift-giving (S. E. Beatty, et al., 1991). Thus, personal values (PV) can determine the

motivation of GGB as the antecedent of GGB. This interpretation could be supported by theoretical and empirical studies. For theoretical support, Rokeach (1986) defined a value as one type of belief which is located in the central belief system of person (p.124). Thus a value seems to be the most important belief of a person. Also values serve as standards or criteria to guide not only action, but also judgement, choice, attitude, evaluation, argument, exhortation, and rationalization (Williams, 1979, p. 16). Hence, PV can be seen as the antecedent of GGB. For empirical supportive study, Beatty et al.(1991) disposed that certain PV influence certain GGB.

However, a limited number of studies looked at the antecedent of GGB. As mentioned, only the study of Beatty et al.(1991) was mentioned PV as an antecedent of GGB. Although, later, there were a number of the extended studies of GGB and PV, those studies tend to be diversified across culture, especially in Asian, which personal values in these studies were linked to cultural value such as Japan (S. E. Beatty, et al., 1993; Lotz, et al., 2003), Hong Kong (Yau, et al., 1999), Korean (Jackson & Kwon, 2006; Park, 1998), and Chinese (Qian, et al., 2007). More importantly, there is no study about GGB construct. Only one study of Qian et al. (2007) which mainly investigated GGB in China is seemingly like providing some kind of GGB construct. Chinese GGB construct consisted of six Chinese values which are reciprocity, human obligations (renqing), relationship (guanxi), destiny / fate (yuan), family orientation, and face (mianzi), and four dimensions of GGB which are importance of GGB, gift-selection effort, amount of GGB, and brand orientation. Since the main objectives of Quain et al.(2007)'s study is to explore the GGB of Chinese in the occasion of the Chinese New Year and examine the effect of Chinese cultural values toward GGB, so the GGB construct provided in this study was generated for such objectives and only for Chinese context. All in all, this shows a shortage of literature investigating construct of GGB and antecedent of GGB which is very crucial piece of information toward a development of GGB study (S. E. Beatty, Yoon, Grunert, & Helgeson, 1996; Larsen & Watson, 2001).

The gaps of GGB literature which is to be investigated in this study is not only the antecedent of GGB, but also the literature of intangible gift. Despite the two kind of gifts: tangible and intangible gifts are specified in the literature (Belk, 1979; Belk & Coon, 1993; Strass, 1964 cited in Goodwin, et al., 1990, p. 692; Sherry, 1983), the intangible gift is rarely to be explored (Clarke, 2007, 2008). Mostly GGB literature bias to disclose about the tangible gift, so Clarke (2007, 2008) called for more study about intangible gift . Furthermore, in order to precisely identify the GGB construct, all three factors which impact GGB need to be restricted. Those factors are the nature of the gift (Belk, 1979; Otnes, Lowrey, & Kim, 1993; Sherry, 1983), the relationship between the giver and the recipient (Belk, 1979; Wagner, Ettenson, & Verrier, 1990; Wolfinbarger, 1990), and the nature of the occasion (Belk,1982; Heeler et al, 1979). Particularly, the occasion of GGB in the parental literature utilised in general occasion (S. E. Beatty, et al., 1991), so it might be referred to occasional or spontaneous GGB. Unspecific occasion of GGB in the parental literature might allow other influential factors to play a part in the findings. Consequently, the examination of GGB construct of this study is chosen to conduct for the intangible gift such a restaurant choice for dinner, for the close relationship between host and guest such as a closed-friend or a family-member, and for the occasional GGB such a hosting dinner for the guest's visit.

CONCEPTUAL FRAMEWORK

PVs Construct

The PVs construct was retrieved from the List of Values (LOV) scales proposed by Kahle (1983). The LOV scales comprise *self -respect* (SR), *security* (SC), *warm relationship with others* (WR), *sense of accomplishment* (SA), *self –fulfilment* (SF), *sense of belonging* (SB), *being well-respected* (BR), *fun and enjoyment in life* (FE), and *excitement* (EC). The LOV scale was found to be more relevant to consumer behaviour in daily life than the Rokeach Value Survey (RVS) proposed by Rokeach (1973) and the Values And Life Style (VALS) scale developed at SRI International by Mitchell (1983), which was favoured by a number of researchers a few decades ago (S. Beatty, E., Kahle, Homer, & Misra, 1985; Kahle, Beatty, & Homer, 1986). As the LOV scales consist of nine values, compared to 18 instrumental values in RVS and 34 items in VALS, the LOV scale is easier to administer in surveys. In addition, the nine LOV scales were adopted as the PVs construct in the majority of the relevant literature (S. E. Beatty, et al., 1991; S. E. Beatty, et al., 1993; S. E. Beatty, et al., 1996). Therefore, using LOV scales for the PVs construct is more likely to provide reliability, ease of usage, comparability, and generalization of the results.

Kahle (1983) also distinguished a further two perspectives within each of the nine dimensions of value: the internal or external source of control, and the personal, interpersonal or non-personal source of fulfilment, as shown in Table 1. The person who maintains an internal source of control over such aspects as *warm relationship with others, self respect, self fulfilment, sense of accomplish, fun and enjoyment in life,* and *excitement* presents the internal strength to deal with life's problems. The person who perceives an external source of control over *sense of belonging, being well-respected,* and *security* tends to rely more on fate and luck when tackling the same problems in life. As a consequence, the internal control person believes they can control their life whereas the external control person might feel totally different. This aspect of value can be related with another aspect of value, the source of fulfilment (Kahle, 1983).

The various sources of fulfilment – interpersonal, personal, and non-personal – provide a further means for categorising the nine values. Kahle (1983) explains that if the source of fulfilment does not involve a person in relation to fun, success, and security, these values were respectively categorised in terms of non-personal fulfilment of the values *fun and enjoyment in life*, *sense of accomplish*, and *security*. When the source of fulfilment is a person, the individual can receive fulfilment from the self (personal fulfilment) or from another individual (interpersonal fulfilment). The personal fulfilment values consist of *self respect, self fulfilment,* and *being well-respected.* The interpersonal fulfilment values include *warm relationship with others* and *sense of belonging* (Kahle, 1983).

Table 1: Category of LOV with Source of Control and Source of Fulfilment

Source of Fulfilment	Source of Control	
	Internal	**External**
Interpersonal	Warm Relationship with Others (WR)	Sense of Belonging (SB)
Personal	Self Respect (SR) Self Fulfilment (SF)	Being Well-Respected (BR)
Non-personal	Sense of Accomplishment (SA) Fun and Enjoyment (FE) Excitement (EC)	Security (SC)

Source: Adapted from Kahle, 1983, p.280

GGB Construct

In this study, not only the factors from GGB literature are considered, but also the factors from related theory such as Theory of Planned Behaviour (TPB) (Ajzen, 1991) are also included. Theory of Planned Behaviour (TPB) is well-established theory predicting the actual behavior from the intention (Ajzen,1991). Voluntary is the key condition to consider which behavior can be predicted by TPB because the voluntary reflects the intention to perform the particular behavior. GGB is one of the voluntary behaviour in some extents. Normally, people volunteer to select and give a gift even though the norm of occasion or social ritual might play apart. Thus they have intention to perform GGB in some ways. Therefore some factors from TPB literature are incorporated.

Regard to GGB literature, there are three extrinsic criteria affecting on GGB such as the nature of the gift (Belk, 1979; Otnes, et al., 1993; Sherry, 1983), the relationship between the giver and the recipient (Belk, 1979; Wagner, et al., 1990; Wolfinbarger, 1990), and the nature of the occasion (Belk,1982; Heeler et al, 1979). Nonetheless there is only one intrinsic criterion which is the individuality of the giver. However, the only source of intrinsic criterion can be divided into nine factors which are described as the following.

***Attitude toward Behaviour*:** "Attitude is a relatively enduring organization of interrelated beliefs that describe, evaluate, and advocate action with respect to an object or situation with each belief having cognitive, affective, and behavioural components" (Rokeach, 1986, p. 132). Based on the concept of the TPB, people intend to perform a certain behaviour when they have a positive attitude towards such behaviour (Ajzen, 2005). This is the reason why this variable was chosen as one of determinants to predict the behavioural intention in GGB. Providing more than just conceptual support for this variable, some empirical studies have also approved the relationship between attitude toward behaviour and actual behaviour. Macklin and Walker (1988) have provided partial support for idea that attitude impacts on GGB. Although they only found a significant relationship between a negative attitude towards GGB that resulted in spending less money and time on gift-selection, this study still provides some confirmation of the importance of the *attitude toward behaviour* and GGB. The reason for the lack of any significance established in regard to a positive attitude towards GGB (termed the 'joy' of gift-giving) might be related to the effect of other situational

factors on gift-selection, such as the closeness of relationship. However, the role of *attitude toward behaviour* as the determinant of GGB was fully confirmed in the study of Park (1998). In the context of both Korean and American cultures, he observed that the negative *attitude toward behaviour* is related to the obligatory motivation to perform GGB while the positive *attitude toward behaviour* is related to a voluntary motivation to perform GGB. Accordingly, the conceptual and empirical evidence suggests the importance of *attitude toward behaviour* in GGB and is therefore included in the GGB construct.

***Subjective Norm*:** A *subjective norm* is based on the person's perception of social pressure to perform or not perform a given behaviour (Ajzen, 2005). Based on the TPB, people intend to perform a behaviour when they experience social pressure to perform it (Ajzen, 2005). Belk (1979) found that only four percent of GGB is related to no specific occasion, therefore, as the vast majority of GGB is oriented to occasions, it is clear that norms or traditions exert a strong influence on selecting gifts. He also found that the norm-governed occasion influenced both the price of gift (for example, the higher amount spent on wedding gifts) and the type of gift (for example, birthday gifts are often uniquely personal, whereas wedding gifts tend to be more practical. The particular importance of *subjective norms* toward GGB in Asian cultures tends to be strengthened by the influence of cultural values wherein norms or rituals are embedded in PVs, such as face saving, reciprocity and group conformity (Qian, et al., 2007; Yau, et al., 1999). Therefore, the *subjective norm* should play an important role in GGB.

***Perceived Behavioural Control*:** Ajzen (2005) provides a definition of *perceived behavioural control* as the ability to perform the behaviour of interest. Based on the TPB, people intend to perform behaviours such as GGB when they believe they have the means (capability) and opportunities (controllable) to do it (Ajzen, 2005). Although the literature concerning the relationship between GGB and *perceived behavioural control* has not yet been investigated, the conceptual compatibility between GGB and TPB concepts is evident enough to include *perceived behavioural control* in the GGB construct.

***Intensity of Intention*:** In the TRA and TPB, the intention or willingness to perform any volitional behaviour such as GGB can be used to predict the actual behaviour (Ajzen, 2005; Fishbein & Ajzen, 1975). The willingness to perform GGB is similar to the concept of voluntary and obligatory motivations to give gifts (Goodwin, et al., 1990), so the variable of *intensity of intention* is consistent with the GGB construct.

In addition to the incorporation of TPB components of *attitude toward behaviour, subjective norms, perceived behavioural control*, and *intensity of intention* as fundamental elements in the construct of GGB, the extended TPB components such as *self-identity* and *anticipated emotion* should also be considered for inclusion due to the complexity of the GGB concept. Indeed, although the *self-identity* and *anticipated emotion* dimensions are drawn from the extended TPB construct, the underpinning principle of these two dimensions actually originates from the concept of GGB. Hence, the two variables of *self-identity* and *anticipated emotion* can be implemented in this study.

***Self-identity*:** Biddle, Bank, and Slavings (1987) defined *self-identity* as "the labels people use to describe themselves" (p. 326). Similarly, Hagger and Chatzisarantis (2006) note that *self-identity* is a set of enduring characteristics that people ascribe to themselves. Hagger et al (2007) state that *self-identity* influences behavioural intention and thereby serves as a

source of information when people plan to perform a given behaviour. A number of studies in social sciences and psychology acknowledge the impact of *self-identity* (self concept) on behaviour (Hagger, Anderson, Kyriakaki, & Darkings, 2007). In particular, GGB can symbolically demonstrate the *self-identity* or self concept of a giver or recipient, or both (Belk, 1979; Sherry, 1983; Wolfinbarger, 1990). Furthermore, *self-identity* has been proposed as the determinant of the gift-selection process in the balance theory of Belk (1976). Evidence from the available literature clearly demonstrates that *self-identity* is a vital element of the GGB construct.

***Anticipated Emotion*:** Emotions or feelings can play an important role in the GGB as they can be seen as a primary form of communicative message between giver and recipient (Belk, 1979; Sherry, 1983; Wolfinbarger, 1990). In Belk's (1979) study of GGB it was revealed that only 19 percent of respondents perceived GGB as not enjoyable and less than 2 percent actually disliked the activity. This clearly illustrates the importance of emotions and feelings in GGB. Furthermore, it also was found that gift-givers directed their focus on others when selecting a gift (Belk, 1979). Thus it can be assumed that the giver expects a positive response from the recipient in terms of *anticipated emotion*. Similarly, French et al. (2005) discussed 'anticipated affect' as the feelings or emotions that respondents expect to feel about the consequences of a behaviour. Apart from the closeness in the relationship between a giver and a recipient, a number of studies have shown that the strength of feelings or emotions attached to the gift are revealed in giving expressive gifts or gifts of higher value (Belk, 1979; Komter & Vollebergh, 1997; Wagner, et al., 1990; Wolfinbarger, 1990). The *anticipated emotion* is mentioned as a crucial factor in the experience of GGB (Clarke, 2008). Hence, *anticipated emotion* should be one of the determinants in the GGB construct.

All in all, six factors of TPB are included in the GGB construct: four factors from the original TPB – *attitude toward behaviour, subjective norms, perceived behavioural control, intensity of intention*; and two taken from extended TPB – *self-identity* and *anticipated emotion*. However, the GGB construct is quite unique in that the giver considers not only the dimension of the self but also the influential factors that play a part in the decision-making processes of purchasing a gift. Therefore, relying on the TPB model alone will not adequately capture the essence of the GGB construct. Following careful examination of studies previously undertaken in this research area, three additional dimensions of the GGB construct are proposed: *motivation of GGB, information searching*, and *gift-selection effort*.

***Motivation of GGB*:** Motivation is defined as an internal factor that arouses, directs, and integrates a person's behaviour in a given set of circumstances in order to achieve some goal (Murray, 1964). The importance of the *motivation of GGB* has been mentioned in most studies of GGB (Belk, 1979; Goodwin, et al., 1990; Sherry, 1983; Wolfinbarger, 1990; Wolfinbarger & Yale, 1993). However, as proposed, there are two types of motivation involved in GGB: motivation to give gifts and motivation to select gifts. The first motive is clearly compatible with the concept of intensity of intention that is already included in the GGB construct. In addition, the agonistic and altruistic motivations to select gifts are also included in the GGB construct.

***Gift-Selection Effort*:** The *gift-selection effort* was the most frequently examined factor in the relevant literature on the GGB construct (S. E. Beatty, et al., 1991; S. E. Beatty, et al., 1993; S. E. Beatty, et al., 1996; Qian, et al., 2007). It is also the most frequently used for

comparisons between purchasing a gift and purchasing for self (Belk, 1982; Heeler, Francis, Okechuku, & Reid, 1979). The research evidence therefore suggests that *gift-selection effort* constitutes an important dimension of the GGB construct.

***Information Searching*:** This variable can be seen as another dimension of the *gift-selection effort*, but it is more important and more specific to the actual process of decision-making when selecting a gift. However, despite its important role in the decision-making process of selecting gifts, this dimension is rarely mentioned in the GGB literature (Heeler, et al., 1979; Horne & Winakor, 1995). As the purpose of the GGB construct is to demonstrate the decision-making involved in gift-selection or gift-purchasing, the variable of *information searching* adds an important dimension to the GGB construct. The absence of attested scales due to the lack of focus on this dimension in the GGB literature, the scale of 'in-store' *information searching* was used as a guideline (Laroche, Cleveland, & Browne, 2004).

In total, nine dimensions representing the GGB construct are utilized in this study: *attitude toward behavior* (AB), *subjective norms* (SN), *perceived behavioural control* (PBC), *intensity of intention* (II), *self-identity* (SI), *anticipated emotion* (AE), *motivation of GGB* (MG), *information searching* (IS), and *gift-selection effort* (GE) as shown in Figure 2.

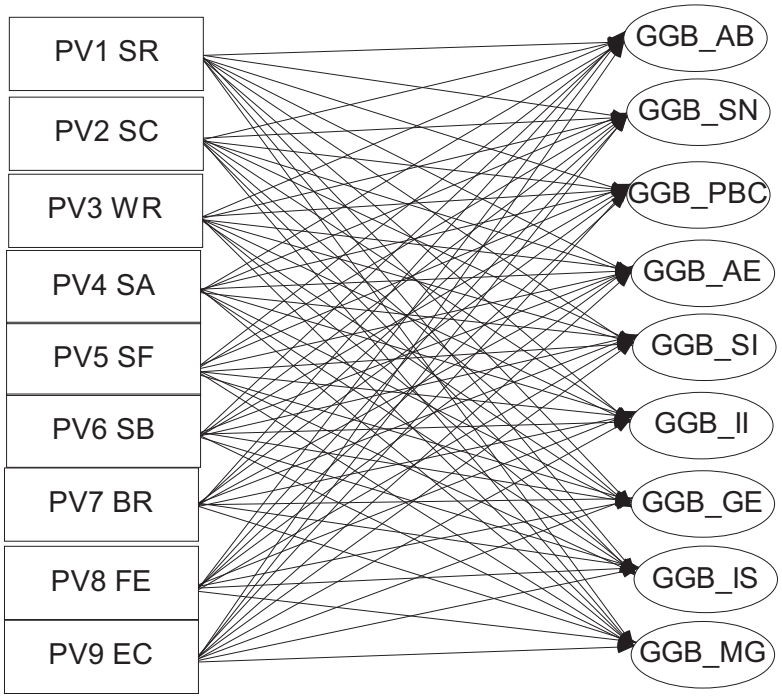


Figure 2: Conceptual Framework

METHODOLOGY

In this study, the multi-item rating scales are applied to measure the underlying construct. The main items to be measured in this study consisted of two constructs: the PV and GGB constructs, as illustrated in Figure 2. Both of the operationalized constructs in this study were derived from the literature. Existing measures were adopted wherever possible. However, some new measures were developed for cases not covered by the existing literature, such as intensity of intention and information searching. The items for the new measures were generated on the basis of conceptual definitions derived from the theoretical construct and the relevant literature. Therefore, the constructs were operationalized with a combination of original, adapted and new items. We work closely with marketing research firm to conduct an online survey. We distributed the web-based questionnaire to the panels with 2 criteria. The respondents must not be a student or unemployed person who leads to limiting a budget to make an appropriate restaurant choice for hosting dinner. This criterion was set up since the issue about the student sample has been raised by number of studies in GGB (Park, 1998; Roberts, 1990; Saad & Gill, 2003). We developed the screening question at the beginning of the questionnaire to avoid this type of respondent. In addition, the respondents must live in Australia (country-specific panels) to make sure about the hosting dinner as a ritual or norm in Australian culture. As a result, 638 qualified respondents were responded back within one month from 15 July 2008 to 12 July 2008. Structural Equation Modelling (SEM) was utilized in analysis the data including Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Table 2 illustrates the demographic details of the 638 respondents of this study.

Table 2: Demographic profile of the respondents

Demographic	Frequency	Percentage (%)
Gender		
Female	306	48
Male	332	52
Total	638	100
Age		
Below 24 years old	61	9.6
25-34 years old	127	19.9
35-44 years old	174	27.3
45-54 years old	155	24.3
55-64 years old	116	18.2
65 years old and above	5	0.8
Total	638	100
Approximate Annual Household Income		
Less than $20,000	25	3.9
$20,000 to $40,000	105	16.5
$41,000 to $60,000	109	17.1
$61,000 to $90,000	165	25.9
$91,000 to $110,000	107	16.8
$110,000 to $150,000	82	12.9
more than $150,000	45	7.1
Total	638	100
Marital status		
Single	202	31.7
De-facto	92	14.4
Married	344	53.9
Total	638	100

Demographic	Frequency	Percentage (%)
Highest Education Level		
Secondary School	182	28.5
Diploma/ TAFE	231	36.2
Undergraduate	113	17.7
Postgraduate	112	17.6
Total	638	100
Number of children in Household		
None	317	49.7
1 to 2	254	39.8
3 to 5	65	10.2
6 and above	2	0.3
Total	638	100
Nationality		
Australian	548	85.9
Others	90	14.1
Total	638	100
Country of birth		
Australia	480	75.2
Others	158	24.8
Total	638	100
Frequency of Dine-Out		
None	59	9.2
1 to 2	342	53.6
3 to 4	152	23.8
5 to 6	46	7.2
More than 6	39	6.1
Total	638	100

Data Analysis

In this study, SEM was utilized to examine the extent of each PV influence each of GGB constructs. The exogenous variables were independent variables which in this study, nine PVs were exogenous. The PVs construct was retrieved from the List of Values (LOV) scales proposed by Kahle (1983) comprising of *self -respect* (SR), *security* (SC), *warm relationship with others* (WR), *sense of accomplishment* (SA), *self-fulfilment* (SF), *sense of belonging* (SB), *being well-respected* (BR), *fun and enjoyment in life* (FE), and *excitement* (EC). The role of exogenous variable was to predict endogenous variables which were represented by nine dimensions of GGB: *attitude toward behavior* (AB), *subjective norms* (SN), *perceived behavioural control* (PBC), *intensity of intention* (II), *self-identity* (SI), *anticipated emotion* (AE), *motivation of GGB* (MG), *information searching* (IS), and *gift-selection effort* (GE). The hypothesis was that each PV has impact toward each GGB as shown in the figure of conceptual framework.

From EFA, there was slightly rearranged of some items in GGB construct which result to rename those constructs. They were labelled as *attitude toward behaviour* (AB), *subjective norms* (SN), *perceived behavioural control* (PBC), *self-identity toward self* (SIS), *self-identity toward others* (SIO), *anticipated emotion* (AE), *purchase-decision involvement* (PDI), *self-experienced motivation* (SM), and *symbolic of gift* (SG). Table 3 summarizes the factor loadings for the condensed forty-three item scale. The significant loading of all the items on the single factor indicates uni-dimensionality. Furthermore, the value of Cronbach's

alpha ranged between 0.683 and 0.931, which exceeds or equals the minimum acceptable value of 0.7 (Nunnally, 1978). Overall, this GGB construct displayed validity and reliability.

Table 3: EFA Output of GGB Construct (KMO=0.929, VAR= 68.10)									
Items	**Components**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Factor 1: Attitude toward Behaviour (AB): Cronbach's alpha=0.910, EV=13.624, VAR=32.439									
The feeling about choosing a restaurant for hosting dinner: Negative/Positive	0.670								
The feeling about choosing a restaurant for hosting dinner: Reluctant/Enthusiastic	0.780								
The feeling about choosing a restaurant for hosting dinner: Unimportant/Important	0.693								
The feeling about choosing a restaurant for hosting dinner: Useful/Useless	0.929								
The feeling about choosing a restaurant for hosting dinner: Bored/Excited	0.937								
The feeling about choosing a restaurant for hosting dinner: Unpleasant/Pleasant	0.758								
Factor 2: Subjective Norms (SN): Cronbach's alpha=0.832, EV=3.550, VAR=8.451									
People who are important to me choose a restaurant for hosting dinner in the same way as me.		0.870							
People in my life whose opinions I value consider the same criteria as I do in choosing a restaurant for hosting dinner.		0.852							
Many people choose a restaurant for hosting dinner in the same way as me.		0.835							
Most people who are important to me would approve my choice of restaurant.		0.567							
Factor 3: Perceived Behavioural Control (PBC): Cronbach's alpha=0.892, EV=2.262, VAR=5.386									
For me, choosing a restaurant for hosting dinner would be easy/difficult			0.879						
I am confident in choosing the right restaurant to satisfy my guest's preference.			0.784						
If I want to, I can choose the most appropriate restaurant for hosting dinner.			0.738						
I feel that I have control over the choice of restaurant for hosting dinner.			0.793						
It is mostly up to me to choose a restaurant for hosting dinner			0.614						
Factor 4: Anticipated Emotion (AE): Cronbach's alpha=0.931, EV=2.043, VAR=4.864									
The guest would feel about the selected restaurant: Excited				0.755					
The guest would feel about the selected restaurant: Delighted				0.849					
The guest would feel about the selected restaurant: Happy				0.782					

The guest would feel about the selected restaurant: Satisfied				0.731					
The guest would feel about the selected restaurant: Proud				0.910					
The guest would feel about the selected restaurant: Grateful				0.855					
The guest would feel about the selected restaurant: Impressed				0.870					
Factor 5: Self-Identity toward Others (SIO): Cronbach's alpha=0.739, EV=1.977, VAR=4.707									
You perceive yourself as: Easygoing					0.649				
You perceive yourself as: Respectful					0.836				
You perceive yourself as: Generous/Kind					0.835				
Factor 6: Self-Identity toward Self (SIS): Cronbach's alpha=0.740, EV=1.583, VAR=3.770									
You perceive yourself as: Egocentric						0.856			
You perceive yourself as: Pretentious						0.825			
You perceive yourself as: Altruistic						0.646			
You perceive yourself as: Show Off						0.691			
Factor 7: Purchase-Decision Involvement: Cronbach's alpha=0.889, EV=1.338, VAR=3.187									
I collect a lot of information about restaurants before making a final choice							0.777		
I consider restaurant reviews from leading magazines/newspapers before making a final choice							0.720		
The amount of time I spend comparing restaurants is worth the effort.							0.618		
I search for more information about restaurants than what is provided by media.							0.842		
I really have to do research on the restaurants in order to find out what is good and bad about them.							0.857		
I put a lot of time and effort into my choice of restaurant.							0.810		
I choose a restaurant very carefully.							0.686		
It is important to initially check out the restaurant before deciding to go there.							0.667		
Factor 8: Self-Experienced Motivation (SM): Cronbach's alpha=0.683, EV=1.192, VAR=2.837									

I choose the restaurant that I like.								0.562	
I tend to take my guest dining out in my favourite restaurant.								0.858	
When choosing a restaurant for hosting dinner, I am inclined to choose a restaurant that I have previously visited.								0.851	
Factor 9: Symbolic of Gift (SG): Cronbach's alpha=0.786, EV=1.032, VAR=2.457									
I choose the restaurant that reflects my personality and status.									0.766
I choose the restaurant that reflects my guest's personality and status.									0.811
I choose the restaurant that reflects my feelings toward the guest.									0.595

CFA was conducted for the model of the GGB construct derived from the EFA previously described and PVs construct derived from the well-established scale of LOV(Kahle, 1983). A measurement model was drawn and tested (see Figure 3.1) and the output showed that $X^2(1229)=4274.71$, GFI=.779, AGFI=.753, CFI=.865, TLI=.854, and RMSEA=.062 (see Table 4). Although RMSEA was acceptable, all goodness of fit indexes illustrated poor fit to the data. Hence, the model was re-specified as shown in Figure 3.2. The best outcome of thirty-seven items for nine factors was maintained in this construct except for the *self-experienced motivation* (SM) factor, which is removed because of the high correlation and high residual covariance amongst them. The new output illustrated: $X^2(593)=1562.88$, GFI=.882, AGFI=.860, CFI=.932, TLI=.924, and RMSEA=.051 which displayed a fairly good fit of this construct as shown in Table 4. The construct ranged their standardized loading from 0.567 to .940, which was acceptable (Hair et al., 1998) as shown in Table 5. In conclude, the six PVs and the eight GGBs were maintained in the construct.

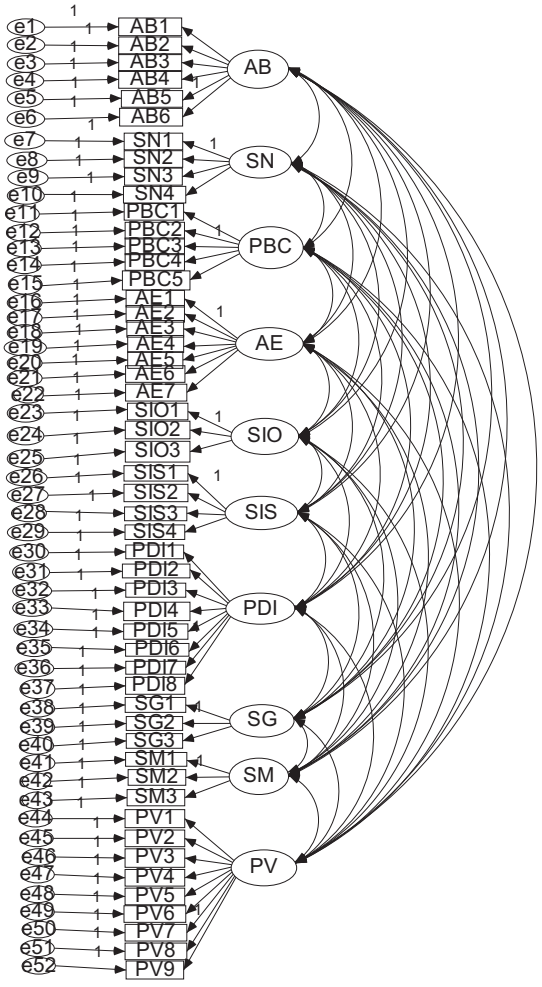


Figure 3.1: Null Measurement Model

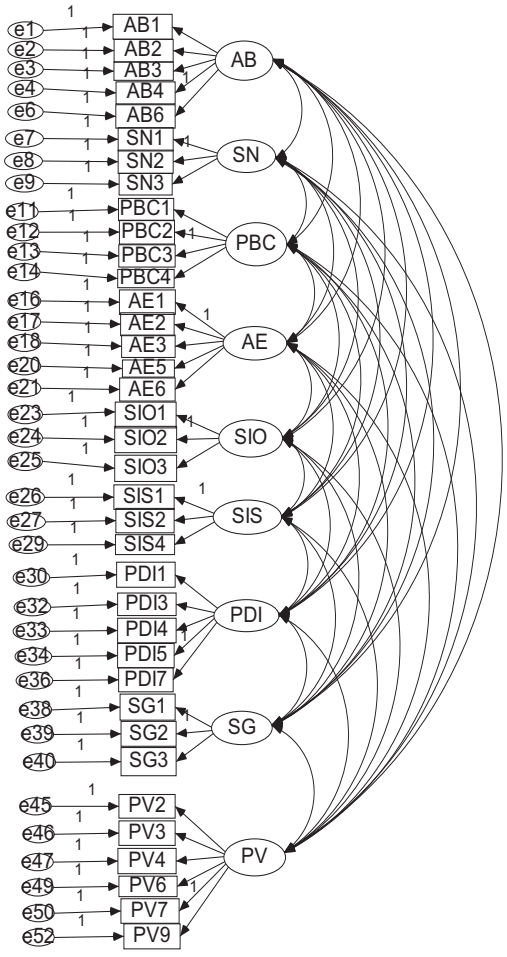


Figure 3.2: Measurement Model

Key: AB=Attitude toward Behaviour, SN=Subjective Norms, PBC=Perceived Behavioural Control, SIS=Self-Identity toward Self, SIO=Self-Identity toward Others, AE=Anticipated Emotion, PDI=Purchase-Decision Involvement, SG=symbolic of gift, and PV=personal Values

Table 4: Comparison of the outputs from original and modified PVs Constructs

	X^2 with DF	**X^2/DF**	**GFI**	**AGFI**	**CFI**	**TLI**	**RMSEA**
Model 3.1	X^2 (1229)=4274.71	3.48	0.779	0.753	0.865	0.854	0.062
Model 3.2	X^2 (593)=1592.88	2.636	0.882	0.860	0.932	0.924	0.051

The structural model of path diagram between two constructs was prepared prior to analysis, as shown in Figure 4. The exogenous variables were the following independent variables: *security* (SC), *warm relation with others* (WR), *sense of accomplishment* (SA), *sense of belonging* (SB), *being well-respected* (BR), and *excitement* (EC). The role of exogenous variables was to predict the endogenous variables, represented by the eight dimensions of GGB: *attitude toward behaviour* (AB), *subjective norms* (SN), *perceived behavioural control* (PBC), *self-identity toward self* (SIS), *self-identity toward others* (SIO), *anticipated emotion* (AE), *purchase-decision involvement* (PDI), and *symbolic of gift* (SG). The AMOS output of the structural model demonstrated: $X^2(566) = 1529.34$, $X^2/DF = 2.702$, GFI=.886, AGFI=.858, CFI=.933, TLI= .921 and RMSEA=.052. Although the values of RMSEA, CFI, and TLI presented a relatively good fit, some of the other fit indexes showed relatively mediocre fit to the data.

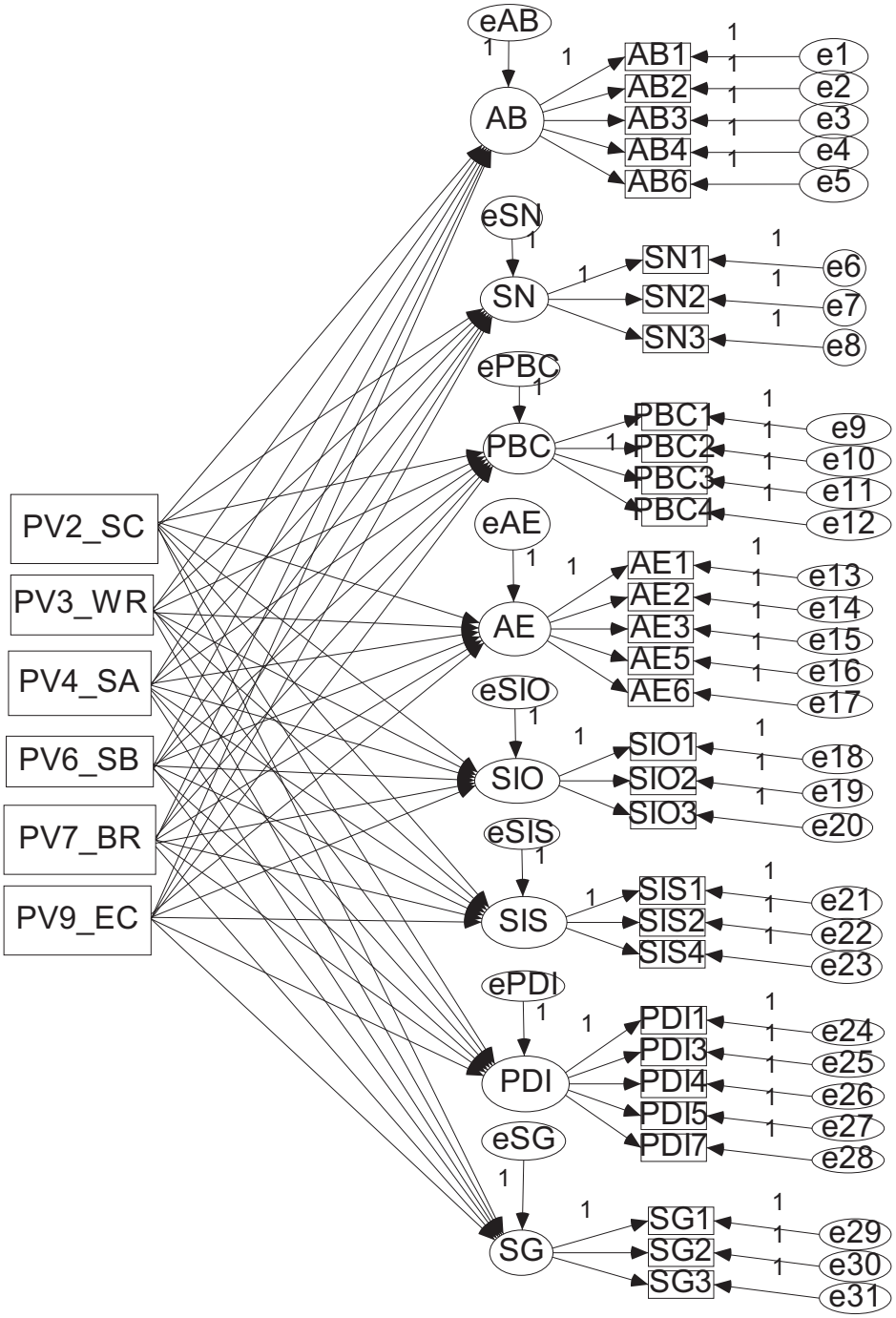


Figure 4: Structural Model for the constructs of PVs and GGB

Key: AB=Attitude toward Behaviour, SN=Subjective Norms, PBC=Perceived Behavioural Control, SIS=Self-Identity toward Self, SIO=Self-Identity toward Others, AE=Anticipated Emotion, PDI=Purchase-Decision Involvement, and SG=symbolic of gift

RESULTS

The assumption that PVs as antecedent of GGB was supported by the confirmation of the construct between the PV and the GGB. The PVs-GGBs construct composed of 6 PVs (*security* (SC), *warm relation with others* (WR), *sense of accomplishment* (SA), *sense of belonging* (SB), *being well-respected* (BR), and *excitement* (EC)) and 8 dimensions of GGB (*attitude toward behaviour* (AB), *subjective norms* (SN), *perceived behavioural control* (PBC), *self-identity toward self* (SIS), *self-identity toward others* (SIO), *anticipated emotion* (AE), *purchase-decision involvement* (PDI), and *symbolic of gift* (SG)). Additionally, it was confirmed that certain values influence certain dimensions of the GGB construct.The output of relationships between those 2 constructs was demonstrated in Table 5.

Table 5: Relationship between GGB Constructs and Personal Values (PVs)

GGB construct	PVs construct	Regression Weights		T-values	P-Values
		Unstandardised	Standardised		
AB	SC	.074	.072	1.352	.176
	WR	**.119**	**.104**	**2.028**	**.043***
	SA	.075	.072	1.243	.214
	SB	.080	.084	1.337	.181
	BR	.085	.073	1.255	.210
	EC	**.231**	**.236**	**4.623**	***
SN	SC	.097	.091	1.495	.135
	WR	.070	.061	1.038	.299
	SA	-.089	-.084	-1.271	.204
	SB	.103	.106	1.486	.137
	BR	.070	.059	.888	.375
	EC	**.149**	**.150**	**2.582**	**.010***
PBC	**SC**	**.094**	**.095**	**1.773**	**.076^{t}**
	WR	**.163**	**.152**	**2.930**	**.003****
	SA	**.123**	**.126**	**2.163**	**.031***
	SB	-.021	-.023	-.362	.717
	BR	**.125**	**.114**	**1.953**	**.051^{t}**
	EC	**.154**	**.168**	**3.275**	***
AE	**SC**	**.146**	**.173**	**3.830**	***
	WR	**.171**	**.186**	**4.259**	***
	SA	**.088**	**.106**	**2.156**	**.031***
	SB	-.026	-.034	-.645	.519
	BR	**.115**	**.123**	**2.492**	**.013***
	EC	**.218**	**.278**	**6.387**	***
SIO	**SC**	**.072**	**.139**	**2.704**	**.007****
	WR	**.275**	**.491**	**8.641**	***
	SA	-.012	-.024	-.427	.669
	SB	**-.076**	**-.161**	**-2.649**	**.008****
	BR	**.166**	**.290**	**5.000**	***
	EC	.029	.061	1.243	.214

SIS	SC	-.006	-.006	-.097	.923
	WR	**-.341**	**-.291**	**-4.894**	***
	SA	.059	.056	.837	.403
	SB	-.010	-.010	-.138	.890
	BR	**-.238**	**-.200**	**-2.978**	**.003****
	EC	**.335**	**.335**	**5.671**	***
PDI	SC	.086	.080	1.377	.168
	WR	-.029	-.025	-.442	.659
	SA	-.011	-.010	-.161	.872
	SB	**.180**	**.184**	**2.663**	**.008****
	BR	.117	.099	1.543	.123
	EC	**.141**	**.142**	**2.527**	**.011***
SG	SC	.073	.080	1.353	.176
	WR	-.040	-.041	-.718	.473
	SA	-.089	-.099	-1.529	.126
	SB	**.155**	**.188**	**2.655**	**.008****
	BR	.097	.097	1.493	.136
	EC	**.170**	**.202**	**3.507**	***

***Sig. at P<.001, **Sig. at P<.01,*Sig. at P<.05, ^{t} Sig. at P<.10

Those results can be discussed within two aspects. The first one is focus on PV aspect and the other one is concentrate on GGB aspect. Regard to the focus of this study mainly on PVs influence GGB, so this discussion will be concentrated on PV aspect (see in Table 6). The most obvious conclusion is Excitement (EC) reflects the highest number of significant relationships while Sense of Accomplishment (SA) relates to the lowest. People who hold EC as their main value tend to actively engage in GGB because they tend to consider more dimensions when performing GGB, which is opposite to people who hold SA. In terms of the EC characteristic, GGB might be perceived as one of enjoyable and exciting behaviour because the individual who rates EC highly prefers to spend time in enjoyable and exciting activities more than others (Kahle, 1983), so people who hold EC value seem to strive for this behaviour. It is worth noting that in previous studies (S. E. Beatty, et al., 1991; S. E. Beatty, et al., 1993; S. E. Beatty, et al., 1996), the EC value was underrepresented for two reasons: it was either included with Fun and Enjoyment (FE) or, in some studies, this combination was eliminated from analysis altogether because of too few respondents. On the other hand, the SA characteristic is a 'male-oriented' goal that represents a devotion of more time to accomplishing 'career-oriented' tasks (Kahle, 1983), so GGB might not be considered an important activity for this kind of person (Fischer & Arnold, 1990). In contrast, GGB has been perceived as a female task (Caplow, 1982; Saad & Gill, 2003; Sherry & McGrath, 1989), so males are traditionally less involved in this kind of activity. Thus SA might be the PV that involves GGB the least. The only reason when the SA value relates to GGB might be seen as an obligatory occasion, when it is necessary to give gifts. That is reflected in the absence of Attitude toward Behaviour (AB).

Table 6: Integration of relationship between PVs and GGB construct

		PERSONAL VALUES					
		SC	WR	SA	SB	BR	EC
GGB CONSTRUCT	AB		*				***
	SN						*
	PBC	t	**	*		t	***
	AE	***	***	*		*	***
	SIO	**	***		**	***	
	SIS		***			**	***
	PDI				**		*
	SG				**		***

*** P<.001, ** P<.01,* P<.05, t P<.10

Secondly, although Warm Relationship with Others (WR) represented the second highest significant relationship after the EC value, it still can confirm the previous studies that people who hold the WR value have a strong preference for involvement in GGB (S. E. Beatty, et al., 1991; S. E. Beatty, et al., 1993; S. E. Beatty, et al., 1996). Supported by Kahle (1983) is the notion that the WR value involves a great deal of mutual give and take as well as sensitivity to others' feelings, so people who hold this value have a strong desire for involvement in interpersonal activity such as GGB. Interestingly, people who hold the Being Well-Respected (BR) value displayed the same significant relationships as those who valued WR, except in regard to Attitude toward Behaviour (AB), which means that the BR value may also reflect involvement with GGB to similar levels as those with the WR value, even if their attitude indicates the opposite. This group of values reflect a desire to be respected or approved by others, so GGB is a tool to establish such respect or approval for them. They did not attach any specific attitude when performing GGB, so that is the reason why the BR value did not have a significant relationship with the AB construct. It is interesting to note whether this group of respondents prefer choosing a utilitarian or expressive gift compared to those who value WR. The GGB literature (Johnson, 1974; Wagner, et al., 1990; Wolfinbarger, 1990) indicates there is a likelihood that utilitarian gifts will be chosen by this group because it does not contain any personal feeling. Besides, due to the lack of AB, the GGB for this group might occur only in response to the occasion mode or, in other words, under obligatory motivations. Similar to the BR value, the people who hold the Security (SC) value also show high involvement with GGB in order to feel secure within society. Proponents of this can be seen as the significant relationships in same categories of the BR such as PBC, AE, and SI. Due to an absence of the AB construct, they give gifts based on traditional, ritual or common practice in order to feel secure in their place within society.

Finally, the people who hold the Sense of Belonging (SB) value differ significantly from those in other categories. Normally, all kinds of PVs illustrated a significant relationship with PBC and AE, which can be seen as fundamental criteria that are considered when performing GGB; however, these two criteria were absent from people who hold the BR value. Instead, the other two criteria, PDI and SG, which are rarely considered important by almost all other value groups, play a significant role in the BR value. This might stem from the attempt to belong to a particular group in society, so the SB group try to please other people through GGB. This can be reflected in the significant relationship with both Purchase-Decision Involvement (PDI) and Symbolic of Gift (SG). The SB group put a lot of effort into searching information and interprets the meaning of the gift in their giving behaviour. However, similar

to the BR, SC and SA groups, the SB group perceive GGB as a tool for them to receive some sense of belonging in return for their GGB, which is the reason why the AB value is absent from this group as well. All in all, with the exception of SA and SB values, all PVs have a significant relationship with PBC, AE and SI. This may be evident that the primary concerns of people in GGB circumstances mostly are about their own resources, the recipient's emotion, and self-identity.

CONTRIBUTION, LIMITATION AND FUTURE RESEARCH

The contribution of this study can be distinguished into theoretical and practical aspects. In theoretical contribution, as outlined in the previous section, only the WR and EC values illustrated a significant relationship with AB, so it might be concluded that it is only individuals who hold these two PVs that apply their real desire when performing GGB. In other words, only individuals from the WR and EC groups apply voluntary motivation when they give a gift. Based on this conclusion, we propose that AB can be used to predict motivation to give a gift, whether voluntary or obligatory (Goodwin, et al., 1990). Furthermore it seems that SN should be utilised as another predictor of motivation to give a gift as well because it shows the force from other people in order to perform GGB. Thus it can indicate the level of obligatory perceived by individual. However, due to the specific context of this study of gift-giving in a close relationship, SN might not play a significant role for this situation. Nonetheless, the direction of effect between AB and SN should be opposite in order to identify voluntary or obligatory motivation. For example, if any PV has positive AB (+AB), it should have negative SN (-SN) in order to apply purely voluntary motivation. In contrast, negative AB (-AB) and positive SN (+SN) should represent obligatory motivation. In some situations, AB (+AB) and SN (+SN) can be both positive, which represents the mixture of voluntary and obligatory motivation. Therefore, future study should examine whether SN can be used with AB in order to predict the motivation to give a gift and whether the relationship between AB and SN can predict the motivation to give a gift.

Similarly, SIO and SIS also can be used to predict the altruistic or agonistic motivation to select a gift (Sherry, 1983). The person who has SIO tends to consider other people more than the person who has SIS. Thus their motivation when selecting a gift seems to be more altruistic than agonistic. On the other hand, the person who has SIS is more likely to agonistically select a gift according to their own preference rather than that of the recipient. In other words, if a person perceives their self-identity in relation to others (+SIO) more than toward self (-SIS), that person demonstrates altruistic motivation. In contrast, if a person perceives their self-identity predominantly in relation to self (+SIS) rather than others (-SIO), that person would be more likely to be driven by agonistic motivation. From this study we conclude that, when selecting a gift, the SC and SB values that showed a significant relationship with SIO are more likely to reflect altruistic motivations whereas the EC value, which showed a significant relationship with SIS is more likely to reflect agonistic motivations. The WR and BR values, which illustrated a significant relationship with both SIO and SIS can be seen as utilising combination of both motivations.

All in all, certain PVs can lead to certain 'motivations to give gifts' and 'motivations to select gifts'. The findings of this thesis show that the SC and BR values demonstrate altruistic motivations. This might be explained by the fact that they are both external sources of control values, so they consider the recipient's interests in order to please their recipient and receive a

sense of security and respect in return. Although both WR and EC values reflect voluntary motivations, the WR value led to altruistic while the EC value led to agonistic motivations. The SA value did not involve any motivation at all. The SB value displayed only non-altruistic motivation. Finally, the EC value reflected both voluntary and obligatory motivations. Therefore, we can conclude that each PV can lead to different motivation to give and select a gift. In addition, the voluntary motivation to give a gift can lead to both altruistic and agonistic motivations to select a gift, which is supported by the study undertaken by Park (1998).

However, this study can be seen as the first study of GGB construct, so the need for future research to be further examined in other context such as GGB for distant relationship might be fruitful. Additionally, the interesting points from this study should be more investigated such as: the most important dimension of GGB construct such as *perceive behavioural control*, *anticipated emotion*, and *self-identity* are still valid in other context; or the role of subjective norm might be increasing in GGB for distant relationship; or the warm relationship with others value in GGB for distant relationship might illustrate the impact toward symbolic of gift and purchase-decision involvement; or the differences of the gift choice from each continuum of PV and motivation. As important as testing the GGB construct, the need to develop the well-defined scale for GGB is also benefit for the further research.

More than segmenting target market, PV can be engaged in other marketing activities such as media and promotional event selection. PV segmentation is included as one of the psychographic segmentation (Tynan & Drayton, 1987). Since the psychographic segmentation focus on lifestyle, activities, interests, opinions, needs, and values (Tynan & Drayton, 1987), so the implication for marketing communication is directly relevant. Marketing managers could be planned the media exposure and promotional event engaging more precise and effective when applying psychographic segmentation. From the study of Beatty et al.(1985) in USA, certain value dictated certain media preferences, leisure activities, and some behaviour such as GGB. Therefore the advantage of PV segmentation as of psychographic segmentation is obviously seen as the tool for generating marketing communication plan. From our findings in this study, we can draw a summary of relationships between each PV and the various dimensions of the GGB construct and restaurant preference, as outlined in Table 7.

Since this is the first study of this particular aspect of GGB, there are few limitations which need to be considered. The lack of well-defined of GGB measurement scales from literatures (S. E. Beatty, et al., 1996; Larsen & Watson, 2001) might limit the efficacy of the model. Particularly, the antecedent of GGB such as GGB construct has not been explored, so the scales had to be developed from other literatures such as TPB. Consequently, due to the conceptual compatibility between GGB and TPB, the practical compatibility might need to be validated. The construct of TPB has been borrowed as part of the model, but the context of GGB which lends more affective behaviour can cause more complexity and might not be perfectly fitted with some of the components from TPB. Also the generalisation of the model might be limited because this study was examined in only one context, obligatory GGB toward the close relationship within only Australia. Therefore, to validate this model, further research in other GGB context and countries is to be required.

Table 7: Summary of PVs, GGB and Restaurant Preference

PV	Corresponding GGB Dimension	Restaurant Preference
Security (SC)	-Perceived Behavioural Control (+PBC) -Anticipated Emotion (+AE) -Self-Identity toward Others (+SIO)	Individuals with dominant SC values... -believed they can select the proper restaurant choice for their guest. -expected the guest will be perceived a positive feeling from this hosting dinner. -tended to select the restaurant which their guest preferred.
Warm Relationship with Others (WR)	-Attitude toward Behaviour (+AB) -Perceived Behavioural Control (+PBC) -Anticipated Emotion (+AE) -Self-Identity toward Others (+SIO) -Self-Identity toward Self (-SIS)	Individuals with dominant WR values... -enjoyed selecting a restaurant for hosting a dinner. -believed they can select the proper restaurant choice for their guest. -expected the guest will be perceived a positive feeling from this hosting dinner. -tended to select the restaurant which is the most favourite of their guest only. -seemed not to select the restaurant from merely their preference.
Sense of Accomplishment (SA)	-Perceived Behavioural Control (+PBC) -Anticipated Emotion (+AE)	Individuals with dominant SA values... -believed they can select the proper restaurant choice for their guest. -expected the guest will be perceived a positive feeling from this hosting dinner.
Sense of Belonging (SB)	-Self-Identity toward Others (-SIO) -Purchase-Decision Involvement (+PDI) -Symbolic of Gift (+SG)	Individuals with dominant SB values... -seemed not to select the restaurant which they preferred. -devoted their time for searching and screening a lot of information about restaurant before choosing

PV	Corresponding GGB Dimension	Restaurant Preference
		the appropriate restaurant. -tended to consider about meaning of restaurant such as personality and status when selecting a restaurant for their guest.
Being Well Respected (BR)	-Perceived Behavioural Control (+PBC) -Anticipated Emotion (+AE) -Self-Identity toward Others (+SIO) -Self-Identity toward Self (-SIS)	Individuals with dominant BR values... -believed they can select the proper restaurant choice for their guest. -expected the guest will be perceived a positive feeling from this hosting dinner. -tended to select the restaurant which is the most favourite of their guest only. -seemed not to select the restaurant from merely their preference.
Excitement (EC)	-Attitude toward Behaviour (+AB) -Subjective Norms (+SN) -Perceived Behavioural Control (+PBC) -Anticipated Emotion (+AE) -Self-Identity toward Self (+SIS) -Purchase-Decision Involvement (+PDI) -Symbolic of Gift (+SG)	Individuals with dominant EC values... -enjoyed selecting a restaurant for hosting a dinner. -considered opinion from others in order to select a proper restaurant. -believed they can select the proper restaurant choice for their guest. -expected the guest will be perceived a positive feeling from this hosting dinner. -tended to select the restaurant which was aligned to their preference. -devoted their time for searching and screening a lot of information about restaurant before choosing the appropriate restaurant. -tended to consider about meaning of restaurant such as personality and status when selecting a restaurant

PV	Corresponding GGB Dimension	Restaurant Preference
		for their guest. -Also it is possible that the selected restaurant might be the most popular restaurant in the town or 'talk of the town' in order to perceive feeling of excitement.

CONCLUSION

The primary aim of this study was to develop and validate the GGB construct. Through rigorous explorative and confirmatory approaches, a multi-dimensional GGB construct was successfully developed with the following dimensions: *attitude toward behaviour, subjective norm, perceived behavioural control, anticipated emotion, self-identity toward others, self-identity toward self, purchase-decision involvement,* and *symbolic of gift*. This study also explored the relationship between personal values and the GGB construct. Analysis of structural model of such relationships demonstrates that a variety of different relationships exist between each of the dimensions of PVs and each of the dimensions of GGB. This newly developed GGB construct will assist researchers in better understanding the behaviour of consumers when purchasing gifts. Marketers will also benefit from the insights that such a multi-dimensional model can provide when formulating their marketing strategies to better attract consumers who are selecting and purchasing gifts for close friends and relatives.

REFERENCES

1. Ajzen, I. (2005). *Attitudes, Personality and Behaviour* (2 ed.): Open University Press.
2. Beatty, S., E., Kahle, L. R., Homer, P., & Misra, S. (1985). Alternative Measurement Approaches to Consumer Values: The List of Values and the Rokeach Value Survey. *Psychology and Marketing, 2*(3), 181-200.
3. Beatty, S. E., Kahle, L. R., & Homer, P. (1991). Personal Values and Gift-Giving Behaviours: A Study Across Cultures *Journal of Business Research, 22*, 149-157.
4. Beatty, S. E., Kahle, L. R., Utsey, M., & Keown, C. (1993). Gift-Giving Behaviours in the United States and Japan: A Personal Values Perspective. *Journal of International Consumer Marketing, 6*(1), 49-66.
5. Beatty, S. E., Yoon, M. H., Grunert, S. C., & Helgeson, J. G. (1996). An Examination of Gift-Giving Behaviours and Personal Values in Four Countries. In C. Otnes & R. F. Beltramini (Eds.), *Gift Giving: A Research Anthology*. Bowling Green, OH: Bowling Green State University Popular Press.
6. Belk, R. W. (1976). It's the Thought that Counts: A Signed Digraph Analysis of Gift-Giving. *Journal of Consumer Research, 3*(December), 155-162.
7. Belk, R. W. (1979). Gift-Giving Behavior. In J. Sheth (Ed.), *Research in Marketing* (Vol. 2, pp. 95-126). Greenwitch, CT: JAI Press.
8. Belk, R. W. (1982). Effects of Gift-giving Involvement on Gift Selection Strategies. *Advances in Consumer Research, 9*(ed. Andrew Mitchell, Ann Arbor), 408-412.

9. Belk, R. W., & Coon, G. S. (1993). Gift Giving as Agapic Love: An Alternative to the Exchange Paradigm Based on Dating Experiences. *Journal of Consumer Research, 20*(3), 393-417.
10. Biddle, B. J., Bank, B. J., & Slavings, R. L. (1987). Norms, Preferences, Identities, and Retention Decisions. *Social Psychology Quarterly, 50*(4), 322-337.
11. Caplow, T. (1982). Christmas Gifts and Kin Networks. *American Sociological Review, 47*(June), 383-392.
12. Clarke, J. (2007). The Four S's of Experience Gift Giving Behaviour. *Hostpitality Management, 26*(1), 98-116.
13. Clarke, J. (2008). Experiences as Gifts: From Process to Model. *European Journal of Marketing, 42*(3/4), 365-389.
14. Fischer, E., & Arnold, S. J. (1990). More than a Labor of Love: Gender Roles and Christmas Gift Shopping. *Journal of Consumer Research, 17*(3), 333-345.
15. Fishbein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. US: Addison-Wesley.
16. French, D. P., Sutton, S., Hennings, S. J., Mitchell, J., Wareham, N. J., Griffin, S., . . . Kinmonth, A. L. (2005). The Importance of Affective Beliefs and Attitudes in The Theory of Planned Behaviour: Predicting Intention to Increase Physical Activity *Journal of Applied Social Psychology, 35*(9), 1824-1848.
17. Goodwin, C., Smith, K. L., & Spiggle, S. (1990). Gift Giving: Consumer Motivation and the Gift Purchase Process. *Advances in Consumer Research, 17*(1), 690-698.
18. Hagger, M. S., Anderson, M., Kyriakaki, M., & Darkings, S. (2007). Aspects of Identity and their Influence on Intentional Behaviour: Comparing Effects for Three Health Behaviours. *Personality and Individual Differences, 42*, 355-367.
19. Hagger, M. S., & Chatzisarantis, N. L. D. (2006). Self-Identity and the Theory of Planned Behaviour: Between- and Within- Participants Analyses. *British Journal of Social Psychology, 45*(4), 731-757.
20. Heeler, R., Francis, J., Okechuku, C., & Reid, S. (1979). Gift Versus Personal Use Brand Selection. *Advances in Consumer Research, 6*(ed. William L. Wilkie, Ann Arber), 325-328.
21. Horne, L., & Winakor, G. (1995). Giving Gifts of Clothings: Risk Perceptions of Husbands and Wives. *Clothing and Textiles Reserach Journal, 13*(2), 92-101.
22. Jackson, V. P., & Kwon, H. J. (2006). Gift Giving: The Interaction between Gender, Gift Recipient, and Group Identity Importance by Product Category. *Journal of Korean Society, 30*(12), 1759-1767.
23. Johnson, C. L. (1974). Gift giving and Reciprocity among the Japanese Americans in Honolulu *American Ethnologist, 1*(2), 295-308.
24. Kahle, L. R. (1983). *Social Values and Social Change*. New York, NY.: Praeger.
25. Kahle, L. R., Beatty, S., E., & Homer, P. (1986). Alternative Measurement Approaches to Consumer Values: The List of Values (LOV) and Values and Life Style (VALS). *Journal of Consumer Research, 13*(3), 405-409.
26. Komter, A., & Vollebergh, W. (1997). Gift Giving and the Emotional Significance of Family and Friends. *Journal of Marriage and the Family, 59*(3), 747-757.
27. Laroche, M., Cleveland, M., & Browne, E. (2004). Exploring Age-Related Differences in Information Acquisition for a Gift Purchase. *Journal of Economic Psychology, 25*(1), 61-95.
28. Larsen, D., & Watson, J. (2001). A Guide Map to the Terrain of Gift Value. *Psychology and Marketing, 18*(8), 889-906.

29. Lotz, S. L., Shim, S., & Gehrt, K. C. (2003). A study of Japanese Consumers' Cognitive Hierarchies in Formal and Informal Gift-Giving Situations. *Psychology and Marketing, 20*(1), 59-85.
30. Mitchell, A. (1983). *The Nine American Life Styles*. New York: Warner.
31. Murray, E. J. (1964). *Motivation and Emotion*. NJ: Prentice-Hall.
32. Nunnally, J. C. (1978). *Psychometric Theory* (2 ed.). New York: McGraw-Hill Book Company.
33. Otnes, C., Lowrey, T. M., & Kim, Y. C. (1993). Gift Selection for Easy and Difficult Recipients: A Social Roles Interpretation. *Journal of Consumer Research, 20*(2), 229-244.
34. Park, S. Y. (1998). A Comparison of Korean and American Gift-Giving Behaviour. *Psychology and Marketing, 15*(6), 577-593.
35. Qian, W., Razzaque, M. a., & Keng, K. A. (2007). Chinese Cultural Values and Gift-Giving Behaviour. *Journal of Consumer Marketing, 24*(4), 214-228.
36. Roberts, S. D. (1990). Symbolism, Obligatory, and Fiber Choice: The Macro to Micro Continuum of Understanding Gift Giving. *Advances in Consumer Research, 17*(eds. Marvin E. Goldberg and Gerald Gorn and Richard W. Pollay, Provo, UT : Association for Consumer Research), 707-709.
37. Rokeach, M. (1973). *The Nature of Human Values*. N.Y.: The Free Press.
38. Rokeach, M. (1986). *Beliefs Attitudes and Values*. Sanfrancisco, California: Jossey-Bass Inc.
39. Saad, G., & Gill, T. (2003). An Evolutionary Psychology Perspective on Gift Giving among Young Adults. *Psychology and Marketing, 20*(9), 765-784.
40. Sherry, J. F. (1983). Gift Giving in Antropological Perspective. *The Journal of Consumer Research, 10*(2), 157-168.
41. Sherry, J. F., & McGrath, M. A. (1989). Unpacking the Holiday Presence: A Comparative Ethnography of Two Gifts Stores. *Interpretive Consumer Research*, 148-167.
42. Tynan, A. C., & Drayton, J. (1987). Market Segmentation. *Journal of Marketing Management, 2*(3), 301-335.
43. Wagner, J., Ettenson, R., & Verrier, S. (1990). The Effect of Donor-Recipient Involvement on Consumer Gift Decisions. *Advances in Consumer Research, 17*(1), 683-689.
44. Williams, R. M. (1979). Change and Stability in Values and Value system: A Sociological Perspective. In M. Rokeach (Ed.), *Understanding Human Values*. New York, N.Y.: The Free Press.
45. Wolfinbarger, M. F. (1990). Motivations and Symbolism in Gift-Giving Behavior. *Advances in Consumer Research, 17*(1), 699-706.
46. Wolfinbarger, M. F., & Yale, L. J. (1993). Three Motivation for Interpersonal Gift Giving: Experiental, Obligated and Practical Motivations. *Advances in Consumer Research, 20*, 520-526.
47. Yau, O. H. M., Chan, T. S., & Lau, K. F. (1999). The Influence of Chinese Cultural Values on Consumer Behaviour: A Proposed Model of Gift-Purchasing Behaviour in Hong Kong. *Journal of International Consumer Marketing, 11*(1), 97-116.

Authors:
Dr. Peeraya Lekkumporn (Corresponding Person)
Address: Marketing Department, Faculty of Business Administration, Kasetsart University:
50 Ngamwongwan Road, Ladyao, Jatujak, Bangkok 10900 Thailand
Email: Peeraya.Lekkumporn@gmail.com
Telephone: +66-81-859-4969, +66-82-450-1299
Fax: +66-2-942-8778

Biography:

Dr. Peeraya Lekkumporn is a lecturer of Marketing at Kasetsart University) in Bangkok, Thailand. She was graduated her DBA from Monash University in Melbourne, Australia. Her subjects are Principle of Marketing, Consumer Behaviour, Services Marketing, and Integrated Marketing Communication. The research interests are consumer behavior, services marketing, and consumer psychology.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

EFFECTIVENESS OF POLISH AND FOREIGN DISDCRIMINANT MODELS

Sławomir Juszczyk, Warsaw University of Life Sciences – SGGW, Poland
Faculty of Economic Sciences
e-mail: slawomir_juszczyk@sggw.pl

Rafał Balina, Warsaw University of Life Sciences – SGGW, Poland
Faculty of Economic Sciences
e-mail: rafal_balina@sggw.pl

ABSTRACT

This article focuses on a study whose thesis was to ascertain whether current bankruptcy forecasting models are effective in relation to companies involved in international commercial road transport. In the case of the international commercial road transport sector, the best foreign model – in terms of overall performance – was the Altman III model with 80% accuracy, followed by the Altman II model with a performance rating of 77.5% for this sector. These results, in effective identification of bankrupt and solvent companies by the use of foreign discriminant models, indicate limited accuracy in their application under the structural and legal conditions in Poland. During research regarding the effectiveness of contemporary models, it was observed that there are Polish discriminant models that are based on multiple tests (with regard to commercial entities), which can be utilized in assessing bankruptcy risk in the considered sector. The best Polish models for assessing bankruptcy risk in the commercial road transport sector were the Poznan (Hamrol and others) models and the Hadasik IV model which had a performance assessment of 82.5%. In the case of other models, their performance ran at lower percentages and therefore could not be considered for analyzing commercial entities in the studied sector.

Keywords: bankruptcy, bankruptcy forecast, discriminant analysis

RANGE AND RESEARCH METHODOLOGY

The study encompassed 60 corporate entities in the international road transport industry in the years 2007 to 2010, incorporated in the Polish Republic as limited liability companies, using their balances and profit and loss accounts. The sample selection was governed by purposive-random format. For the two phase study, sixty companies were selected wherein for the first phase, 20 ‘bankrupted in 2009’ companies were randomly chosen. A further 20 were chosen having continuous activity; and for this determinant model construction phase, the data from 40 companies for 2007 and 2008 was examined; two full ‘pre-bankruptcy’ accounting periods were scrutinized. The commonalities of these 40 companies were utilized in examining the effectiveness of foreign and domestic determinant models. For the second phase of the study, another 20 companies, which were declared bankrupt in 2011, were randomly chosen. The same ‘continual activity’ group of the first phase was utilized but with the change that the data of both bankrupt and operating companies now pertained to 2009 and 2010. The collated data was used to verify the determinant model for a specific industry. The study took into account bankrupt companies which issued annual financial reports for at least

3 full accounting periods in *Monitor Polski B* (a Polish government daily regarding finances, reports, etc.) before petitioning a court to declare bankruptcy, and also were characterized by deficit spending (negative net worth) and financial losses. The contrasted side, those companies which were operational in 2011 since at least January 1, 2005, had comparable asset values to the bankrupt group with differentials no greater than 500,000. PLN. In 2009, Poland had 51 international transport companies declare bankruptcy; solvent - 529 companies.

The established bankrupt group was then organized ascending, according to their National Court Register number, and twenty companies were chosen at random. Every second company was chosen beginning with the company in fifth position. The 'in operation' group was randomly established, also in that after being ordered by registration number, every twenty-sixth company was chosen beginning with the company in fourth position. In 2011, there were 49 companies in the international commercial road transport industry which declared bankruptcy; of these, once organized in ascending order, every second company was drawn beginning with the fifth position. To assess accuracy of company classification, an assessment accuracy matrix was applied to the discriminant model, a tool which presents summaries pertaining to index accuracy (see, among others [Card 1992, pp. 431-439], [Congalton 1991, pp. 35-46], [Li, Racine 2007, p. 240]). This accuracy tool is the square 'k x k' matrix where 'k' equals the number of deciding classes. Matrix rows reflect correct decision classification, and the matrix column represents the determinant model estimates. The general matrix classification scheme, utilizing discriminant analysis to assess the accuracy of a prediction model to foresee bankruptcy, is shown in Table 1.

Table 1. Assessment Matrix for Discriminant Model Accuracy

	Anticipated Model-Based Classification	
Factual Company Classification	Bankruptcy Risk	No Bankruptcy Risk
Bankruptcy Risk	Correct Classification	Incorrect Classification
No Bankruptcy risk	Incorrect Classification	Correct Classification

Source: original on the basis of Altman E. I., (1996), Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy, *Journal of Finance*, No 4, Vol. XXIII, pp. 598-599.

This presentation of the results pertaining to forecast accuracy allows the determination of the model's effectiveness. In the case of determinant analysis, three types of effectiveness and incorrect classification. In the case of 'model effectiveness', we see [Prusak 2004, p. 6]:

Effectiveness - First Degree (SP_2) establishes the percent of accurately classified companies at risk of bankruptcy, determined according to the formula –

$$SP_1 = \frac{P_1}{P_1 + NP_1} \cdot 100\%$$

Effectiveness – Second Degree (SP_2) establishes what percent of all analyzed companies as not-at-risk of bankruptcy were identified accurately, based on the formula –

$$SP_2 = \frac{P_2}{P_2 + NP_2} \cdot 100\%$$

Overall Effectiveness (SP_0) – demonstrates what percent of all companies analyzed were classified correctly by the model. The formula enabling effectiveness determination is –

$$SP_0 = \frac{P_1 + P_2}{P_1 + NP_1 + P_2 + NP_2} \cdot 100\%$$

Where the formulae use these symbols:

P_1 – anticipated number of bankrupted companies classified as 'at risk',
P_2 – anticipated number of operational companies classified as 'not at risk',
NP_1 – number of operational companies classified as 'at risk',
NP_2 – number of bankrupted companies classified as 'not at risk'.

Determining the validity of the model and its forecast degree of error, in the test group and the group used for formulating the model, enabled model assessment with regard to practical applicability.

STUDY RESULTS

Research regarding performance assessment of constructed discriminant models, both those for the Polish and foreign markets, was an issue of interest for many researchers, among them Stasiewski [1996, Rachunkowość nr 12], Gasza [1997, Bank i Kredyt nr 3], Rogowski [1997, Bank i Kredyt nr 6], Koralun-Bereźnicka [2006, ZN KZ i F nr 69] and many others. They indicated a need to develop a discriminant model specifically for Polish conditions where the imminent bankruptcy discriminant models for highly developed economies showed low accuracy in anticipating bankruptcy of Polish enterprises.

It bears noting that the Polish discriminant models were formulated over a period of 'a couple' of decades, during which time many significant changes occurred in the methods of corporate management; the commercial milieu has changed and the Polish market continues to transform. These transformations signaled the need for application verification of models for forecasting, or anticipation of, imminent bankruptcy (see [Grice, Dugan, 2001, p. 122], [Sojak, Stawicki, 2001, pp. 45-52]). Accuracy assessment of discriminant models for Polish market conditions have been undertaken, among others, by Kisielińska [2010, pp. 17-31], Waszkowski [2011, pp. 96-106], Czapiewski [2009, pp. 118-128], Stefański i Sabuhoro [2006, pp. 225-246], Grzegorzewska i Runowski [2008, pp. 83-90], Juszczyk [2010, pp. 572-584], Balina [2009, pp. 161-174; 2012a, pp. 225-263; 2012b, 231-238], Dec [2008, p. 129], and their results have indicated lowered accuracy -- shortly after their introduction -- in differentiating potential fiscal failures and solvent enterprises. Accuracy verification was undertaken on the basis of varied companies in a given industry profile. It bears mentioning that rarely is there a Polish discriminant model available to indicate potential bankruptcy for a specific industry profile. An exception is the research carried out by Stefanski [2011, pp. 131-139], who examined the applicability of Polish discriminant models to assess bankruptcy potential for Polish securities banks listed by the Warsaw Stock Exchange, as well as Juszczyk[1], who carried out effectiveness verification for Polish and foreign determinant bankruptcy models for the transport sector. Resulting from the current trend for bankruptcy analysis from a particular industrial perspective [Sojak, Stawicki, 2001, pp. 89-102], it would seem appropriate to verify Polish and foreign bankruptcy models for corporate entities in three distinctly different industries.

[1] For more see [Juszczyk, 2010, pp. 572-584].

As the authors have put to use financial data of limited liability companies, further examination will exclude models constructed for publicly owned (joint stock) or other lawful incorporation. The parameters pertaining to this current study have restricted the number of bankruptcy prognostic models that can be examined, and verification of foreign bankruptcy prognosticating models has been restricted to Altman II, Altman III, Springete, Legault and van Frederikslust I models.

Concurrently the applicability of Polish models for predicting corporate bankruptcy in the above mentioned industry was undertaken maintaining the given parameters. The qualifying models were: Pogodziński and Sojak, Gajdki and Stos I, Gajdki and Stos II, Hadasik I, Hadasik II, Hadasik III, Hadasik IV, Wierzba, Stępień and Strąk I, Stępień and Strąk II, Stępień and Strąk III, Stępień and Strąk IV, Hołda, INE PAN (Mączyński and Zawadzki) I, INE PAN (Mączyński and Zawadzki) II, INE PAN (Mączyński and Zawadzki) III, INE PAN (Mączyński and Zawadzki) IV, INE PAN (Mączyński and Zawadzki) V, INE PAN (Mączyński and Zawadzki) VI, INE PAN (Mączyński and Zawadzki) VII, Appenzeller and Szarzec I, Appenzeller and Szarzec II, Poznański, Prusak I, Prusak II, Prusak IV oraz Juszczyk.

ACCURACY ASSESSMENT OF SELECTED FOREIGN DISCRIMINANT MODELS

The accuracy verification of the foreign models as the pertained to the analyzed industry was begun with judgment of applicability in the context of anticipating bankruptcy. The effectiveness of Altman's models (I, II, III), Springete's. Legault's, and van Fredrikslust's models are shown in Table 2.

Table 2 – Accuracy of Foreign Models in Forecasting Bankruptcy Risk for Companies in the International Transport Sector [%]

Model	SP_1	SP_2	SP_0
Altman II	85.0	70.0	77.5
Altman III	60.0	100.0	80.0
Springete	70.0	25.0	47.5
Legault	35.0	100.0	67.5
van Fredrikslust I	100.0	0.0	50.0

Source: own research.

For companies involved in international commercial road transport, the highest accuracy was found in Altman's III model (80%), followed by Altman's II model (77.5%), and Legault's model (67.5%). It should be noted that these results deviate from Altman's indicated general accuracy in his own studies [1968, pp. 589-609; 1983, pp. 89-102]. If the model is to be judged as useful, its general accuracy should be greater than 80% [Korol, Prusak 2005, pp. 19-34]. Therefore, applying foreign models to international transport companies which have their headquarters in Poland should be undertaken with caution since the error risk is at least 20% - a relatively high level.

ACCURACY ASSESSMENT OF POLISH COMMERCIAL SECTOR DETERMINANT MODELS

To uncover company bankruptcy risk factors in the studied commercial branches, an examination of models developed in Poland was undertaken for accuracy. The results of that rating are presented in Table 3.

Table 3 – Accuracy of Polish Models in Forecasting Bankruptcy for International Road Transport Companies [%]

Model	SP_1	SP_2	SP_0	Model	SP_1	SP_2	SP_0
Pogodzińska i Sojak	85.0	5.0	45.0	INE PAN I	100.0	10.0	55.0
Gajdki i Stos I	50.0	50.0	50.0	INE PAN II	85.0	45.0	65.0
Gajdki i Stos II	30.0	90.0	60.0	INE PAN III	85.0	45.0	65.0
Hadasik I	95.0	60.0	77.5	INE PAN IV	90.0	50.0	70.0
Hadasik II	80.0	70.0	75.0	INE PAN V	95.0	30.0	62.5
Hadasik III	80.0	80.0	80.0	INE PAN VI	80.0	50.0	65.0
Hadasik IV	65.0	100.0	**82.5**	INE PAN VII	70.0	85.0	77.5
Wierzba	75.0	65.0	70.0	Appenzeller and Szarzec I	80.0	50.0	65.0
Stępień and Strąk I	80.0	65.0	72.5	Appenzeller and Szarzec II	80.0	45.0	62.5
Stępień andStrąk II	60.0	95.0	77.5	Poznański	80.0	85.0	**82.5**
Stępień and Strąk III	90.0	0.0	45.0	Prusak I	50.0	90.0	70.0
Stępień and Strąk IV	45.0	95.0	70.0	Prusak III	40.0	85.0	62.5
Hołda	100.0	0.0	50.0	Prusak IV	80.0	20.0	50.0
Juszczyk	60.0	80.0	70.0				

Source: own research.

In the case of international commercial road transport, the highest accuracy (82.5%) was seen in two models: Posnański and Hadasik IV.
In the case of twenty out twenty-seven Polish models examined with regard to forecasting potential bankruptcies and solid operations, significant variation was observed between the first and second orders tests, which in effect limit their use in predicting bankruptcy in the given commercial branch.

Noted should be that the Polish models, and foreign as well, gave varying results oscillating between 76.7% (Altman III), and 49.2% (Stepien and Strak III). This indicates a significant potential for confusion and incorrect readings regarding potential bankruptcy or solvent operation occurring from availability of models and their various indications.

The construction of a highly accurate determinant model for the international commercial road transport companies with headquarters in Poland was undertaken as a result of the major inadequacy of most Polish and foreign models in assessing bankruptcy risk.

CONCLUSIONS AND RECOMMENDATIONS

In the case of the international commercial road transport sector, the best foreign model – in terms of overall performance – was the Altman III model with 80% accuracy, followed by the Altman II model with a performance rating of 77.5% for this sector. These results, in effective identification of bankrupt and solvent companies by the use of foreign discriminant models, indicate limited accuracy in their application under the structural and legal conditions in Poland.

During research regarding the effectiveness of contemporary models, it was observed that there are Polish discriminant models that are based on multiple tests (with regard to commercial entities), which can be utilized in assessing bankruptcy risk in the considered sector. The best Polish models for assessing bankruptcy risk in the commercial road transport sector were the Poznan (Hamrol and others) models and the Hadasik IV model which had a performance assessment of 82.5%. In the case of other models, their performance ran at lower percentages and therefore could not be considered for analyzing commercial entities in the studied sector.

BIBLIOGRAPHY

1. Altman E. I., [1968], Financial Ratios, Discriminate analysis and the prediction of corporate bankruptcy, *Journal of Finance*, Nr 23, Vol. 4.
2. Altman E. I., [1983], *Corporate Financial Distress: A Complete Guide to Predicting, Avoiding and Dealing with Bankruptcy*, Wiley & Sons, Toronto.
3. Altman E. I., Haldeman R. G., Narayanan P., [1977], ZETA ANALYSIS, a new model to identify bankruptcy risk of corporations, *Journal of Banking & Finance*, Vol. 1.
4. Balina R. [2012a], Skuteczność modeli do prognozowania bankructwa przedsiębiorstw handlu hurtowego żywnością, napojami i wyrobami tytoniowymi, *ZN SGGW, Ekonomika i Organizacja Gospodarki Żywnościowej*, 96, Wydawnictwa SGGW, Warsaw, 255-263.
5. Balina R. [2012b], Skuteczność wybranych modeli dyskryminacyjnych na przykładzie branży robót budowlanych, ZN Uniwersytetu Szczecińskiego. Finanse. Rynki Finansowe. Ubezpieczenia, Nr 689 (50), pp. 231-238)
6. Balina R., Juszczyk S., [2009], Prognozowanie upadłości przedsiębiorstw spedycyjnych jako bankowe narzędzie decyzyjne, ZN SGGW, *Ekonomika i Organizacja Gospodarki Żywnościowej*, 78, Wydawnictwa SGGW, Warsaw, 61-74.
7. Bauer K. [2010], Kryzys finansowy a restrukturyzacja przedsiębiorstw w stanie upadłości, Prace Komisji Geografii Przemysłu Polskiego Towarzystwa Geograficznego, Procesy transformacji przemysłu i usług w regionalnych i krajowych układach przestrzennych, No. 15, Warsaw-Cracow, 209.
8. Borkowski B., Dudek H., Szczęsny W., [2003], *Ekonometria. Wybrane zagadnienia*, Wydawnictwo naukowe PWN, Warsaw, 93.
9. Card D. H., [1992], Using known map category marginal frequencies to improve estimates of thematic map accuracy, *Photogrammetric Engineering and Remote Sensing*, Vol. 49, 431-439.
10. Charalambous C., Charitou A., Kaourou F., [2000], Comparative analysis of artificial neural network models: Application in bankruptcy prediction, *Annals of Operations Research*, Vol. 99.

11. Chen S. [2011], Modeling default risk with support vector machines, *Journal of Quantitative Finance*, Nr 11[1], 135-154.
12. Chmaj A. [2002], Ocena sytuacji finansowej przedsiębiorstwa, Wydawnictwo Wyższej Szkoły Zarządzania w Rzeszowie, Rzeszów, 95
13. Congalton R. G., [1991], A review of assessing the accuracy of classifications of remotely sensed data, *Remote Sensing of Environment*, Vol. 37, 35-46.
14. Cottrell A., [2006], Gretl Manual. Gnu Regression. Econometrics and Time-series Library, Department of Economics, Wake Forest University, 41-60.
15. Czajka D., [1999], Przedsiębiorstwo w kryzysie: upadłość lub układ, Wydawnictwo Zrzeszenia Prawników Polskich, Warszawa, 65
16. Czapliewski L., [2009], Efektywność wybranych modeli dyskryminacyjnych w przewidywaniu trudności finansowych polskich spółek giełdowych, Zarządzanie finansami firm – teoria i praktyka. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Nr 47, Wrocław, s. 118-128.
17. Davidson R., MacKinnon J., [2004], *Econometric Theory and Methods*, Oxford University Press, New York, 79-92.
18. Dąbrowski B. J., Boratyńska K., [2011], Zastosowanie modeli dyskryminacyjnych do prognozowania upadłości spółek giełdowych indeksu WIG-Spożywczy, *Zeszyty Naukowe SGGW w Warszawie, Ekonomiki i Organizacja Gospodarki Żywnościowej*, Nr 82, Wydawnictwo SGGW, Warsaw, 163-173.
19. Dec P. [2008], *Modele wczesnego ostrzegania przed upadłością przedsiębiorstw i badania nad ich skutecznością w Polsce, Bankructwa przedsiębiorstw*, (red. E. Mączyńska), Wydawnictwo SGH, Warszawa, 219.
20. Dębski W., [2005], *Teoretyczne i praktyczne aspekty zarządzania finansami przedsiębiorstw*, Wydawnictwo PWN,
21. 71-72.
22. Dimitras A., Slowinski R., Susmaga R., Zopounidis C., [1999], Business Failure Prediction Using Pough Sets, *European Journal of Operational Research*, Nr 114, 263-280.
23. Draper N. R., Smith H., [1998], *Applied Regression Analysis*, John Wiley & Sons, New York, 339-342.
24. Dziechciarz J., [2003], *Ekonometria. Metody, przykłady, zadania*, Wydawnictwo Akademii Ekonomicznej, Wrocław, 47-49.
25. Fitzpatrick P. J. [1932], A comparison of ratios of successful industrial enterprises with those of failed firms, *Certified Public Accountant*, Vol. 12 October, November, December, 598-605.
26. Folwarski M., [2010], Polskie klasyczne metody wczesnego ostrzegania przed upadłością – zastosowanie na rynku bankowym, *Finanse przedsiębiorstw* [red. Kopiński A.], Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław, 70-76.
27. Franc-Dąbrowska J., [2008], *Zarządzanie finansami przedsiębiorstw: wybrane zagadnienia*, Wydawnictwo SGGW, Warszawa, 91.
28. Franc-Dąbrowska J., [2009], Praktyczne zastosowanie wybranych modeli panelowych do oceny sytuacji finansowej przedsiębiorstw rolniczych, *Zeszyty Naukowe SGGW w Warszawie. Ekonomika i Organizacja Gospodarki Żywnościowej*, Wydawnictwo SGGW, Warszawa, 31

29. Fraser D. R., Fraser L. M., [1996], *Ocena Wyników Działalności Banku Komercyjnego*, Wydawnictwo Związku Banków Polskich, Warszawa, s. 125.
30. Gasza R., [1997], Związek między wynikami analizy typu Altman a kształtowanie się kursów akcji wybranych spółek giełdowych w Polsce. Rezultaty badań najstarszych spółek giełdowych w latach 1991-1995. *Bank i Kredyt*, No. 3.
31. Gatnar E., [1999], Metody wyboru cech w nieparametrycznej analizie dyskryminacyjnej, *Taksonomia*, Nr 6.
32. Góralski P., [2010], *Finanse*, (Red. Podstawka M.), Wydawnictwo Naukowe PWN, Warszawa, 617-646.
33. Grabiński T., Wydymus S., Zeliaś A., [1982], *Metody doboru zmiennych w modelach ekonometrycznych*, Wydawnictwo PWN, Warsaw, 81-85.
34. Grice J., Dugan M., [2001], The Limitations of Bankruptcy Prediction Models: Some Cautions for the Research, *Review of Quantitative Finance and Accounting*, September 2001.
35. Gruszczyński M., Kluza S., Winek D., [2003], *Ekonometria*, Wydawnictwo WSHiFM, Warsaw, 83.
36. Gruszecki T., [2008], Instytucjonalno-prawne regulacje upadłości. Bankructwa przedsiębiorstw. *Wybrane aspekty instytucjonalne*. Red. Mączyńska E., Wydawnictwo SGH, Warsaw, 100
37. Grzegorzewska E., Runowski H., [2008], Zdolności prognostyczne polskich modeli dyskryminacyjnych w badaniu kondycji finansowej przedsiębiorstw rolniczych, *Roczniki Nauk Rolniczych*, Seria G, Tom 95, Zeszyt 3/4, 83-90.
38. GUS, Informacje bieżące [2011], Wskaźnik cen towarów i usług konsumpcyjnych w grudniu 2010 r., Warsaw, 1-4.
39. GUS, Informacje i opracowania statystyczne (2011), Rynek wewnętrzny w 2010 r., Zakład Wydawnictw Statystycznych, Warsaw, 48.
40. GUS, Informacje i opracowania statystyczne, (2011), Wynik finansowe podmiotów gospodarczych I-XII 2011, Zakład Wydawnictw Statystycznych, Warsaw, 16-116.
41. Hadasik D., [1998], Upadłość przedsiębiorstw w Polsce i metody jej prognozowania, *Zeszyty Naukowe*, Seria II, Nr 153, Akademia Ekonomiczna w Poznaniu, Poznań, 135.
42. Jędrzejewski S., *Identyfikacja ryzyka upadłości przedsiębiorstw*, Ostrów Wielkopolski, 2005, 73-74.
43. Jones F., [1987], Current Techniques in Bankruptcy Prediction, *Journal of Accounting Literature*, Nr 6, 89-102.
44. Juszczyk S., [2010], Prognozowanie upadłości przedsiębiorstw. *Ekonomista*, 5, 710-721.
45. Kendall M. G., Buckland W. R., [1975], *A Dictionary of Statistical Terms*, Longman for the International Statistical Institute, London. 12.
46. Kess P., Phusavat K., Takala J., [2008] - Managing external knowledge: framework for organisational life cycles, *International Journal of Innovation and Learning*, Vol. 5, No.3 pp. 255 - 265.
47. Khodadadi V., Zandinia A., Nouri M., [2010], Application of Ants Colony System for Bankruptcy Prediction of Companies listed in Teheran Stock Exchange, *Business Intelligence Journal*, Tom 3, Nr 2, 89-100.
48. Kisielińska A., Waszkowski A., [2010], Polskie modele do prognozowania bankructwa przedsiębiorstw i ich weryfikacja, *Zeszyty Naukowe SGGW w Warszawie. Ekonomika i Organizacja Gospodarki Żywnościowej*, Wydawnictwo SGGW, Warsaw, 82, 17-31.

49. Kisielińska J. [2008], *Modele klasyfikacyjne prognozowania sytuacji finansowej gospodarstw rolniczych*, Wydawnictwo SGGW, Warsaw, 85-120.
50. Kolonko J., [1980], *Analiza dyskryminacyjna i jej zastosowanie w ekonomii*, Wydawnictwo naukowe PWN, Warsaw.
51. Koralun-Bereźnicka J., [2006], Ocena możliwości wykorzystania wybranych funkcji dyskryminacyjnych w analizie polskich spółek giełdowych, *Studia i Prace Kolegium Zarządzania i Finansów*, Zeszyt Naukowy, 69.
52. Korol T., Prusak B., [2005], *Upadłość przedsiębiorstwa a wykorzystanie sztucznej inteligencji*, Wydawnictwo Cedewu, Warsaw, 19-34.
53. Kufel T., [2007], *Ekonometria. Rozwiązywanie problemów z wykorzystaniem programu GRETL*, Wydawnictwo PWN, Warsaw, 53-57.
54. Kumar P. R., Ravi V., [2006], Bankruptcy Prediction in Banks by Fuzzy Rule Based Classifier, IEEE, Transactions on Fuzzy System.
55. Kuryłek W. [2000], Credit scoring – podejście statystyczne, *Bank i Kredyt*, no. 6/2000 73.
56. Lachenbruch P. A., [1975], *Discriminant analysis*, Hafner, New York.
57. Lachenbruch P. A., Goldstein M., [1979], Discriminant Analysis, *Biometrics*, Vol. 35, 69.
58. Lasek M., [1996], *Wielokryterialna ocena kondycji ekonomicznej firm - klientów banku*, Wydawnictwa Uniwersytetu Warszawskiego, Warsaw, 33.
59. Li Q., Racine J. S., [2007], *Nonparametric Econometrics. Theory and Practice*, Princeton University Press, Princeton, 240.
60. Maciejczak M.: Ocena Indeksów Wczesnego Ostrzegania na przykładzie Testu Szybkiego i Indeksu Zh. Czy wyniki zależą od zastosowanej metody?, *Zeszyty Naukowe SGGW – Ekonomika i Organizacja Gospodarki Żywnościowej,* No. 64 [2008], Wyd. SGGW, Warsaw 2008, 271.
Maciejewska J, [2000], *Rachunkowość finansowa*, Wydawnictwo Szkolne i Pedagogiczne, Warsaw, 263-265.
61. Madala G., [2006], *Ekonometria*, Wydawnictwo Naukowe PWN, Warsaw, 204-205
62. Martin A., Gayathri V., Saranya G., Payathri P., Venkatesan P., [2011], A Hybrid Model for Bankruptcy Prediction Using Genetic Algorithm, Fuzzy C-means and Marsi, *International Journal on Soft Computing*, Vol. 2, No. 1, February.
63. Martin D., [1977], Early warning of bank failure: A logit regression approach, *Journal of Banking & Finance*, Vol. 1.
64. Mączyńska E., [2005], *Ekonomiczne aspekty upadłości przedsiębiorstw w Polsce*, Wydawnictwo SGH, Warszawa, 17-16.
65. Mączyńska E., Zawadzki M., [2006], Dyskryminacyjne modele predykcji upadłości przedsiębiorstw, *Ekonomista*, No. 2, 205-217.
66. Merton R. C., [1974], On the Pricing of Corporate Debt: The Risk Structure of Interest Rates, *Journal of Finance*, Vol. 29, No. 2, 449-470.
67. Meyer P. A., Pifer H. W., [1970], Prediction of Bank Failure, *Journal of Finance*, Vol. 25.
68. Nieminen P., Takala J., [2006], Achieving better on-time-delivery performance with the help of internal dependencies in the production, *International Journal of Management and Enterprise Development* 2006 - Vol. 3, No.1/2 pp. 181 - 190.
69. Ohlson J., [1980], Financial Ratios and the Probabilistic Prediction of Bankruptcy, *Journal of Accounting Research*, Vol. 18,1, 109-131.
70. Oldcorn, R., [1989], *Management*, MacMillan, London, 237.

71. Pindyck R. S., Rubinfeld D. L., [1998], *Econometric Models and Economic Forecasts*, McGraw-Hill International Edition, Boston, 156-158.
72. Prusak B., [2004], Jak rozpoznać potencjalnego bankruta?, *Prace Naukowe Katedry Ekonomii i Zarządzania Przedsiębiorstwem*, Tom III, Red. Bławat F., Wydawnictwo Politechniki Gdańskiej, Gdańsk, 182-210.
73. Prusak B., [2004], Metody wykorzystywane w analizie porównawczej modeli oceny zagrożenia przedsiębiorstwa upadłością Międzynarodowa Konferencja Naukowa ENTIME, Gdańsk.
74. Ramanathan R., [1995], *Introductory Econometrics with Applications*, Harcourt Brace College Publishers, San Diego, 422.
75. Rogowski W., [1997], Możliwości wczesnego rozpoznawania symptomów zagrożenia zdolności płatniczej przedsiębiorstwa, *Bank i Kredyt*, 6.
76. Salchenberger L. M., Cinar E. M., Lash N. A., [1992], Neutral networks: A new tool for predicting thrift failures, *Decisions Science* ,Vol. 23.
77. Schumpeter J. A., [1975], *Capitalism, Socialism and Democracy*, Harper, 2nd. ed., New York, 99.
78. Shumway T., [2001], Forecasting bankruptcy more accurately: a simple hazard model, *Journal of Business*, No. 74, 101-124.
79. Sierpińska M., Jachna T., [2004], Ocena Przedsiębiorstwa według standardów światowych, PWN, Wyd. 3, Warszawa, 144-213.
80. Siudek T. [2004], *Analiza finansowa podmiotów gospodarczych*, Wydawnictwo SGGW, Warszawa, 167-177.
81. Sojak S., Stawicki J., [2001], Wykorzystanie metod taksonomicznych do oceny kondycji ekonomicznej przedsiębiorstw, *Zeszyty Teoretyczne Rachunkowości*, 59, 45-52.
82. Sori Z. M., Hamid M. A. A., Nassir A., [2007], Forecasting Financial Problems in Emerging Capital Markets, Social Sciences Research Network.
83. Sprengers A., [2005], Bankruptcy Prediction using Classification and Regression Tree, Bachelor Thesis Informatics and Economics, Faculty of Economics, Erasmus University Rotterdam, August 21.
84. Stasiewski T., [1996], Z-Score – indeks przewidywania upadku przedsiębiorstwa, *Rachunkowość*, 12.
85. Stefański A, Sabuhoro A., [2006], Modele prognozowania zagrożenia finansowego na tle oceny ryzyka przez banki, *Wartość przedsiębiorstwa – z teorii i praktyki zarządzania*, (red. Duraj J.), Wydawnictwo Naukowe Novum, Płock-Łódź, 225-246.
86. Tsakonas A., Dounias G., Doumpos M., ZopounidisC., [2006], Bankruptcy prediction with neural logic networks by means of grammar-guided genetic programming, *Experts Systems with Applications* ,Vol. 30.
87. Wasilewski M., Felczak T., [2011], Strategia płynności finansowej przedsiębiorstw rolniczych w zależności od rentowności aktywów, *ZN SGGW, Ekonomika i Organizacja Gospodarki Żywnościowej*, 91, Wydawnictwo SGGW, Warsaw, 49-50.
88. Waszkowski A., [2011], Methods of classification models for enterprises insolvency prediction. *Acta Scientiarum Polonorum. Oeconomia*, 10(2), Wydawnictwo SGGW, Warszawa, 96-106.
89. Welfe A., [2003], *Ekonometria*, Wyd. III, Wydawnictwo PWN, Warsaw, 20-35.
90. Wędzki D., [2005], Wielowymiarowa analiza bankructwa na przykładzie budownictwa, *Badania Operacyjne i Decyzyjne*, No. 2, 70.

91. Wędzki D., [2008], Przepływy pieniężne w prognozowaniu upadłości przedsiębiorstwa. *Badania Operacyjne i Decyzyjne*, 2, 95.
92. Wilcox A., [1971], A Simple Theory of Financial Ratios as Predictors of Failure, *Journal of Accounting Research*, 389-396.
93. Witkowska D. [red.], [1999], *Metody statystyczne w zarządzaniu*, Wydawnictwo Wydziału Organizacji i Zarządzania Politechniki Łódzkiej, Łódź, 240-241.
94. Witkowska D., [2006], *Podstawy ekonometrii i teorii prognozowania. Podręcznik z przykładami i zadaniami*, Wydawnictwo Oficyna Ekonomiczna, Crakow, 54-83.
95. Wojtkowiak G., [2004]Pozytywny wymiar upadłości, *Zeszyty Naukowe Akademii Ekonomicznej w Poznaniu*, Zeszyt 48, 170-181.
96. Wójcicka A., [2007], *Wybrane nowoczesne metody oceny ryzyka kredytowego, Matematyczne i ekonometryczne metody oceny ryzyka finansowego*, [red. Chrzana P.], Wydawnictwo Akademii Ekonomicznej w Katowicach, Katowice, 41-51.
97. Yang Z. R., Platt M. B., Platt H. D., [1999], Probabilistic neutral Networks in Bankruptcy Prediction, *Journal of Business Research*, Vol. 44.
98. Zeliaś A., [1991], *Ekonometria przestrzenna*, Wydawnictwo PWN, Warsaw, 30-31.
99. Zieliński W, [1998], *Analiza regresji*, Fundacja Rozwoju SGGW, Warsaw.
100. Zimniewicz K., [1990], *Nauka o organizacji i zarządzaniu*, Wydawnictwo PWN, Warsaw, 223.
101. Żmijewski M., [1984], Methodological issues related to the estimation of financial distress prediction models, *Journal of Accounting Research*, Vol. 22.

Proceedings of 2013 International Conference on
Technology Innovation and Industrial Management
29-31 May 2013, Phuket, Thailand

A COMPARISON STUDY BETWEEN ORACLE R12 AND MANUFACTURING PLANNING AND CONTROL THEORY FOR MRP IMPLEMENTATION

Tippamas Chorpha, Department of Industrial Engineering, Faculty of Engineering, Kasetsart University

Pornthep Anussornnitisarn*
Department of Industrial Engineering, Faculty of Engineering, Kasetsart University
***Corresponding author: fengpta@ku.ac.th**

ABSTRCT

ERP is the integrating all businesses function of financial and manufacturing module which has Material Requirement Planning is the backbone to support module of manufacturing in ERP which runs on single database in a client-server environment thus can manage centralize data in order to record, monitor and report for every activity in organization at single point for real-time access so ERP is not concern only manufacturing anymore but embrace all business function. One of the most important modules in ERP system is production planning which apply the manufacturing planning and control theories such as master production schedule (MPS) and material requirement planning (MRP). However, implementing MRP/MRPII in ERP system often cited as failure in many places due to many reason such as different workflow in actual environment and ERP environment, inflexibility of ERP software in accommodating frequently changes demand from customer. Based on previous research, it identified one of the major problems in failing production planning module in ERP system as the workflow difference between theory and ERP system (Open source ERP). The conclusion was that the information presented in ERP system is totally different than general table format of MPS & MRP related theories. The information presented in ERP system lack of critical information that help production planner to make a quick and better decision such as Is overtime needed to complete the job on time? or Should produce certain product to stock for future use etc. User can find out the information but requires access many screens with note taking.

This research extended the previous research by conducting similar research on leading ERP package, Oracle R12 with MPS & MRP related theories. Unlike, open source ERP system, the results show that in Oracle R12, there are information table for production planner to use like MRP table. Even though Oracle R12 tables are differences (more information) than MRP/MPS table in theories, at least production planner can immediately make a decision. However, the problems still be found in Training material on MRP & MPS in Oracle R12. The training materials were not followed the theoretical workflow. As a result, the user has lack of a depth understanding in information presented in Oracle R12 leading to slower decision making process than it should be.